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Environmental Assessment of a Reciprocating Engine Retrofitted with Nonselective Catalytic Reduction
Volume 2. Data Supplement

Acurex Corp., Mountain View, CA

Prepared for

Industrial Environmental Research Lab.
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Jul 84

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ENVIRONMENTAL ASSESSMENT OF A RECIPROCATING ENGINE RETROFITTED WITH NONSELECTIVE CATALYTIC REDUCTION

VOLUME II

DATA SUPPLEMENT

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Contract No. 68-02-3188

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ABSTRACT

The two-volume report describes results obtained from testing a rich-burn reciprocating internal combustion engine retrofitted with a nonselective catalytic reduction system (NSCR) for NO_x reduction. A comprehensive test program was performed to characterize catalyst inlet and outlet organic and inorganic emissions at optimum catalyst NO_x reduction performance, followed by a 15-day exhaust emission monitoring program to measure the catalyst performance under typical engine operating conditions. Over the 1-day comprehensive test period, the NO_x reduction performance of the catalyst ranged between 54 and 81 percent, with an average of 70 percent. NO_x emissions averaged 1700 ppm at the catalyst inlet and 550 at the catalyst outlet. Catalyst inlet CO and TUHC concentrations averaged 14,600 ppm and 115 ppm, respectively. These inlet combustible concentrations were the result of engine operation at an air/fuel ratio near or slightly below the stoichiometry required for efficient NO_x reduction. Catalyst outlet CO and TUHC levels were reduced to 13,200 ppm and 125 ppm, respectively. Total organic emissions were also reduced by the catalyst from 15.5 to 2.1 mg/dscm. Ammonia and cyanide levels increased by factors of 15 and 450, respectively, across the catalyst. Over the 15-day monitoring period, NO_x reduction performance was mostly in the 0 to 40 percent range. Only occasionally did NO_x reduction exceed 90 percent. During these periods of better performance, CO and TUHC emissions at the inlet were as high as 1 percent and 0.1 percent, respectively.

CONTENTS

1. INTRODUCTION 1-1
2. ENGINE OPERATING DATA 2-1
3. SAMPLING DATA SHEETS 3-1
    3.1 SUMMARY TABLES FOR SASS, NH_3, AND HCN SAMPLING SYSTEMS 3-2
    3.2 OPERATING DATA TABLES FOR SASS 3-5
    3.3 OPERATING DATA TABLES FOR NH_3 SAMPLING TRAIN . . 3-24
    3.4 OPERATING DATA TABLES FOR HCN SAMPLING TRAIN . . 3-37
4. ANALYTICAL RESULTS 4-1
    4.1 AMMONIA, CYANIDE, AND N_2O ANALYSES AND PARTICULATE WEIGHTS 4-2
    4.2 TRACE ELEMENT ANALYSIS RESULTS 4-6
    4.3 TOTAL CHROMATOGRAPHABLE ORGANICS (TCO), GRAVIMETRIC ORGANICS (GRAV), INFRARED (IR) SPECTRA, AND GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS) OF TOTAL SAMPLE EXTRACTS 4-23
    4.4 LIQUID CHROMATOGRAPHY (LC) SEPARATION OF THE INLET XAD-2 EXTRACT, WITH TCO, GRAV, AND IR ANALYSES OF LC FRACTIONS 4-31
    4.5 BIOASSAY RESULTS 4-48
    4.6 NATURAL GAS FUEL ANALYSIS 4-53

SECTION 1

INTRODUCTION

The purpose of this data supplement is to document data in greater detail than was possible in Volume I (Technical Results) of this report. It is intended to provide sufficient detail for researchers to perform their own analysis of the data obtained. Readers are referred to the technical volume for objectives, description of source emission results, interpretations, and conclusions.

The remaining sections of this data supplement contain the following information:

- Section 2, Engine Operating Data
  - Engine load, generator output, fuel flow, pressures, and temperatures
- Section 3, Sampling Data Sheets
  - Complete listing of continuous monitor data for entire 15-day test period (computer listing from field data sheets); operating data tables for SASS (for solid particulate, trace elements and organics sampling), and impinger sampling systems for NH_3 and HCN sampling
- Section 4, Analytical Laboratory Results
  - Ammonia, cyanide, and N_2O analysis results, SASS particulate weights, trace element emissions by spark mass spectrometry

(SSMS) analysis and atomic absorption spectroscopy (AAS) analysis; total chromatographable organic (TCO) and gravimetric (GRAV) results and infrared (IR) spectra of total sample extracts; determination of organic compounds by gas chromatography/mass spectrometry (GC/MS); liquid chromatography (LC) fractionation of inlet organic extract with TCO, GRAV, and IR analysis of LC fractions; natural gas fuel analysis.

SECTION 2

ENGINE OPERATING DATA

ENGINE/GENERATOR OPERATING PARAMETERS

Plant SCG Honor Rancho
Location Valencia
Source Waukesha IC Engine

Date June 7 -- Comprehensive Tests
Operator

Time (24-hr)	Generator output (kW)	Engine output (hp)[a]	Engine speed (rpm)	Air intake manifold vacuum (in. Hg)		Fuel regulator pressure (in. H_2O)		Gas meter (10^3 ft^3)	Fuel gas temp (°F)	Stack temp (°F)	Fuel press (psi)	Water temp (°F)	Oil temp (°F)	Vacuum (in. Hg)	Stack press (in. H_2O)	Catalyst temp (°F)		Ambient temp (°F)	
				Left	Right	Left	Right									In	Out	Dry Bulb	Wet Bulb
0845	398	597	905	4.8	5.2	3.7	3.6	107.8	69	1,069	11	169	152	9.2	4.3	1,051	997	--	--
0925	410	615	905	5.1	5.1	3.6	3.5	129.2	70	1,069	11	171	156	9.8	6.1	1,056	1,008	--	--
1045	400	600	905	4.8	4.7	3.7	3.5	170.3	77	1,074	11	171	163	7.8	6.4	1,017	1,005	--	--
1130	400	600	905	4.4	4.5	3.8	3.5	195.9	79	1,068	11	171	166	8.2	6.3	954	1,002	82	--
1210	412	618	900	4.6	4.8	3.8	3.5	215.3	82	1,076	11	172	166	8.2	--	1,013	--	--	--
1340	415	623	905	4.8	4.2	3.7	3.7	264.8	86	1,071	11	173	170	7.2	6.8	--	--	--	--
1435	455	683	905	4.3	4.5	3.8	3.5	299.8	86	1,070	11	174	171	8.0	6.8	997	994	84	71
1512	420	630	910	4.3	4.7	3.6	3.7	315.2	86	1,071	11	172	170	8.2	6.7	997	1,006	84	71
1552	430	645	905	4.3	4.3	3.7	3.5	335.4	84	1,060	11	172	169	7.5	6.3	991	1,022	85	71
1627	425	638	905	4.4	4.1	3.6	3.8	335.9	84	1,070	11	172	171	6.9	7.0	993	1,039	85	71
1655	427	640	905	4.1	4.3	3.6	3.8	372.2	84	1,073	11	172	171	7.5	7.2	1,002	1,042	86	71
1732	430	645	902	4.5	4.6	3.8	3.7	393.2	82	1,070	11	172	170	7.5	6.8	992	1,042	83	70
1802	425	638	905	4.5	4.6	3.8	3.7	409.0	80	1,074	11	172	168	8.0	6.2	--	1,032	79	68
1830[b]	415	623	--[c]	--	--	--	--	421.2	80	1,075	11	--	--	--	--	--	--	--	--

[a] Horsepower was not measured. Estimated to be about 1.5 times the electrical generator output.
[b] Engine operating hours = 5343.7.
[c] Not measured.

ADDITIONAL ENGINE OPERATING DATA -- 15-DAY CONTINUOUS MONITORING PERIOD

Day (June 1983)	Operating hours	Time	Generator output (kW)	Engine output (hp)[a]	Engine speed (rpm)	Stack temp (°F)	Fuel meter (10^3 ft^3)
6	5359.8	1030	225	383			8773.5
		1200	200	300	905		8802.7
	5365.3	1600	260	390	910		8881.5
9	5381.9	0824	160	240	910	900	9213.5
		0900	160	240	910	880	9223.2
		0942	190	285	910	900	9236.5
		1102	215	320	910	926	9262.0
		1143	200	300	910	905	9275.0
	5386.4	1259	210	315	910	893	9299.2
13	5479.9	0957	225	338	900	905	11282.3
		1034	190	285	900	892	11294.4
		1241	220	330	905	890	11333.2
	5484.0	1400	240	360	910	883	11359.0
14	5554.9	1047	275	413	910	1,008	11752.5
		1136	320	480	910	1,045	11773.5
		1317	435	650	905	1,082	11823.0
		1404	450	680	900	1,081	11849.2
		1511	320	480	905	1,078	11884.3
		1553	330	495	910	1,082	11903.5
	5510.9	1643	350	575	910	1,085	11928.5
15	5528.7	1022	415	623	905	1,091	12408.0
		1104	250	375	900	1,022	12430.0
		1152	210	315	900	937	12456.5
		1217	500	750	910	1,031	12465.2
		1253	210	315	905	1,024	12472.2
		1420	250	375	900	989	12504.0
		1454	250	375	905	960	12525.1
	5534.2	1552	230	345	905	966	12535.7
16	5552.4	0959	340	510	905	1,077	12993.5
		1022	380	495	905	1,040	13004.0
		1101	290	435	910	1,041	13021.0
		1124	300	450	910	1,042	13031.0
		1152	310	465	910	1,066	13043.3
		1233	325	490	905	1,060	13062.7
		1241	320	480	910	1,013	13067.0
		1347	290	435	905	1,041	13091.5
		1441	220	330	905	974	13112.5

ADDITIONAL ENGINE OPERATING DATA -- 15-DAY CONTINUOUS MONITOR (continued)

Day (June 1983)	Operating hours	Time	Generator output (kW)	Engine output (hp)[a]	Engine speed (rpm)	Stack temp (°F)	Fuel meter (10^3 ft^3)
		1505	260	390	905	976	13121.9
	5558.5	1600	220	330	910	975	13142.0
17	5576.3	0940	140	210	910	867	13511.8
		1026	225	338	905	977	13526.6
		1048	240	360	905	952	13534.1
		1127	315	470	905	1,013	13549.0
		1203	300	450	905	1,065	13564.0
		1242	330	495	905	1,075	13581.0
		1300	350	525	905	1,070	13599.0
		1316	230	345	905	1,001	13656.0
		1329	350	525	905	1,061	13601.0
		1430	320	480	905	1,066	13628.5
		1531	330	495	905	1,065	13655.8
	5582.5	1552	325	490	905	1,082	13666.1
20	5649.6	1041	250	375	900	934	15164.5
		1306	280	420	905	955	15211.7
		1352	260	390	905	964	15229.0
		1524	270	405	910	958	15264.3
	5655.5	1635	270	407	905	955	15290.0

[a] Horsepower not a measured value. Assumed to correspond to about 1.5 times the generator output.

SECTION 3

SAMPLING DATA SHEETS

3.1 SUMMARY TABLES FOR SASS, NH_3, AND HCN SAMPLING SYSTEMS

3.2 OPERATING DATA TABLES FOR SASS

3.3 OPERATING DATA TABLES FOR NH_3 SAMPLING TRAIN

3.4 OPERATING DATA TABLES FOR HCN SAMPLING TRAIN

3.1 SUMMARY TABLES FOR SASS, NH_3, AND HCN SAMPLING SYSTEMS

ISOKINETIC CALCULATIONS - USEPA: M/5 BASIS

SOUTHERN CAL GAS - NO. 2

RUN NUMBER	2-NH3-O	1-HCN-I	1-HCN-O
DATE OF TEST	6-7-83	6-7-83	6-7-83
OPERATOR	RCB	BCD	BCD
METER VOLUME, CF	18.27	17.316	18.269
METER COEF	0.9908	0.9995	0.9908
BAROMETRIC PRES, HG	28.62	28.62	28.62
DELTA H, IN H2O	1.1	1	1.1
METER TEMP, DEG F	86.6	70.5	87.4
STACK TEMP, DEG F	1026	996	1032
CONDENSATE, ML	91.2	82.4	90.2
PERCENT CO2	10.2	10.2	10.2
PERCENT O2	0.1	0.1	0.1
PERCENT CO	0	0	0
PERCENT N2	89.7	89.7	89.7
STATIC PRES, IN H2O	0.15	0.15	0.15
PITOT COEF	0	0	0
SQRT DELTA P, IN H2O	0	0	0
STACK AREA, SQ FT	0	0	0
NOZZLE DIAM, IN	0	0	0
TEST TIME, MIN	30	30	0
MASS PARTICULATE, G	0	0	0
F-FACTOR, DSCF/MBTU			
VOLUME, DSCF	17.089	16.539	17.063
WATER VAPOR, SCF	4.293	3.879	4.246
PERCENT MOISTURE	0.201	0.190	0.199
MOLECULAR WT DRY, LB/LB	29.636	29.636	29.636
MOLECULAR WT WET, LB/LB	27.30	27.43	27.32
STACK PRES, IN HG	28.63	28.63	28.63
STACK VELOCITY, FT/SEC	0.00	0.00	0.00
MASS FLOW, DSCFM	0	0	0
MASS FLOW, ACFM	0	0	0
PERCENT EXCESS AIR			
PERCENT ISOKINETIC	#DIV/0!	#DIV/0!	#DIV/0!
GRAIN LOADING, GR/DSCF	0.00000	0.00000	0.00000
GRAIN LOADING, GR/ACF	0.00000	0.00000	0.00000
EMISSION RATE, LB/HR-STD	0.00000	0.00000	0.00000
EMISSION RATE, LB/MBTU			

ISOKINETIC CALCULATIONS - USEPA: M/5 BASIS

SOUTHERN CAL GAS - NO. 1

RUN NUMBER	1-SASS-I	1-SASS-O	1-NH3-I	I-NH3-O
DATE OF TEST	6/7/83	6/7/83	6/7/83	6/7/83
OPERATOR	PWK	PWK	BCD	BCD
METER VOLUME, CF	1026.375	1039.64	16.828	18.03
METER COEF	0.974	1.016	0.9995	0.9908
BAROMETRIC PRES, HG	28.55	28.55	28.62	28.62
DELTA H, IN H2O	1.08	1.41	1	1.1
METER TEMP, DEG F	92.2	93.2	64.7	79.6
STACK TEMP, DEG F	997	1029	997.3	1025.5
CONDENSATE, ML	3952	4586	78.6	66.9
PERCENT CO2	10.2	10.2	10.2	10.2
PERCENT O2	0.1	0.1	0.1	0.1
PERCENT CO	0	0	0	0
PERCENT N2	89.7	89.7	89.7	89.7
STATIC PRES, IN H2O	0.15	0.15	0.15	0.15
PITOT COEF	0.79	0.79	0	0
SQRT DELTA P, IN H2O	0.664	0.644	0	0
STACK AREA, SQ FT	0.785	0.785	0	0
NOZZLE DIAM, IN	0.612	0.612	0	0
TEST TIME, MIN	360	320	30	30
MASS PARTICULATE, G	0.0367	0.0376	0	0
F-FACTOR, DSCF/MBTU	0			
VOLUME, DSCF	964.290	935.475	16.251	17.084
WATER VAPOR, SCF	186.021	215.863	3.700	3.149
PERCENT MOISTURE	0.162	0.187	0.185	0.156
MOLECULAR WT DRY, LB/LE	29.636	29.636	29.636	29.636
MOLECULAR WT WET, LB/LB	27.75	27.45	27.48	27.82
STACK PRES, IN HG	28.56	28.56	28.63	28.63
STACK VELOCITY, FT/SEC	60.80	59.94	0.00	0.00
MASS FLOW, DSCFM	830	776	0	0
MASS FLOW, ACFM	2,864	2,823	0	0
PERCENT EXCESS AIR				
PERCENT ISOKINETIC	124.053	144.806	#DIV/0!	#DIV/0!
GRAIN LOADING, GR/DSCF	0.00059	0.00062	0.00000	0.00000
GRAIN LOADING, GR/ACF	0.00564	0.00577	0.00000	0.00000
EMISSION RATE, LB/HR-STD	0.00418	0.00413	0.00000	0.00000
EMISSION RATE, LB/MBTU				

3.2 OPERATING DATA TABLES FOR SASS

ACUREX CORPORATION

Run 1-SASS (INLET)

Acurex Project No. 307735.51

Field Dates 6-6/8-83

Plant Honor Ranch Storage Sta.

Sampling Location Eng 3

Sampling Date 6-7-83

FIELD CREW

Crew Chief: Bruce C. DaRos

Testing Engineer: 1 Pete W. Kaufmann

2 Regan C. Best

C.M. ~~Engr.~~ Technician: 1 Sherman A. Smith

2

3

Lab Technician: 1 Greg Nicoll

2

Process Engineer: 1 Howard B. Mason

2

FIELD SAMPLE REFERENCE NUMBERS:

819363
819366
819381
819380
819362
819383
819369

819372
819377
819375
819378
819393

ISOKINECTIC SAMPLING WORKSHEET

Plant Howar Rancho - Storage Stn. Peformed by Kaufmann
Date 6/7/83
Sample Location Inlet
Test No./Type SASS

$$K = \frac{782.687\ (Cp)^2\ (1-B_{wo})^2\ P_s\ M_d}{K_o^2\ M_s\ P_m}$$

where: K = Contant of fixed and assumed parameters (dimensionless)

Pitot coefficient (dimensionless)	C_p	assume .85
Water vapor in the gas stream (proportion by volume)	B_{wo}	assume .12
Absolute stack gas pressure (in. Hg)	P_s	assume 4.5
Molecular weight, stack gas dry (lb/lb-mole)	M_d	CO_2 - 10 O_2 - 0.2 N_2 - 89.8
Orifice coefficient (dimensionless)	K_o	.9794 3.581
Molecular weight, stack gas wet (lb/lb-mole) $M_d(1-B_{wo}) + 18(B_{wo})$	M_s	
Abolute meter pressure (in. Hg)	P_m	29.55
$\frac{782.687\ (\_\_\_)^2\ (1-\_\_\_)^2\ (\_\_\_)\ (\_\_\_)}{(\_\_\_)^2\ (\_\_\_)\ (\_\_\_)}$	K	35.864

ISOKINECTIC NOZZLE CALCULATION
AND
SAMPLING RATE CALCULATION

Plant Havoc Grucito Storage Sta. Performed by Kaufmann

Date 6/7/83

Sample Location Inlet

Test No./Type SASS

$$N_d = \left(\frac{\Delta H\ T_s}{K\ T_m\ \Delta P}\right)^{.25}$$

where: N_d = Nozzel diameter (inches)

Average pressure differential across the orifice meter (in. H_2O)	ΔH	2.1
Temperature stack gas, average (^oF)	T_s	1000
Temperature of gas meter, average (^oF)	T_m	100
Stack gas velocity pressure (in H_2O)	ΔP	[illegible]
$\left(\frac{(\_\_\_)\ (\_\_\_ + 460)}{(\_\_\_)\ (\_\_\_ + 460)(\_\_\_)}\right)^{.25}$	N_d	

$$\Delta H = K\ (N_d)^4\ \frac{T_m}{T_s}\ (\Delta P)$$

where: ΔH = Pressure differential across the orifice meter (in H_2O)

Nozzel diameter, actual (inches)	N_d	
Temperature of gas meter (^oF)	T_m	
Temperature of stack gas (^oF)	T_s	
Stack gas velocity pressure (in H_2O)	ΔP	
$\left((\_\_\_)\ (\_\_\_)^4\ \frac{(\_\_\_ + 460)}{(\_\_\_ + 460)}\ (\_\_\_)\right)$	ΔH	
Magic number _______( )^4	$K(N_d)^4$	

FIELD DATA

Page 1 of 3

Plant HONOR RANCHO
Date 6-7-83
Sample Location INLET
Sample Type SASS
Run Number 1
Operator P.W. KAUFMANN
Ambient Temperature
Barometric Pressure
Static Pressure, (H_2O)
Filter Number(s)

Leak Check: Initial at ___ " Hg, ___ CFM
Final at 21 " Hg, 0.15 CFM
Pitot Leak Check:

Impinger Volumes

Initial	Final	Net Gain
500		
500		
500		
Silica Gel		

SASS Condensate
Total Volume 3952*

Probe Length and Type 5' SS
Nozzel Size & I.D.
Pitot Coefficient & I.D. .79
Assumed Moisture 12%
Molecular Weight, Dry, (M_d)
Meter Box Number 105
Meter Coefficient 3.581
α Factor 6.974
K = 37.223
$K(Nd)^4$ = ___ x (___)^4 = ___
$\Delta H = K(N_d)^4 \left(\frac{Tm}{Ts}\right)$ (P)

Traverse Point Number	Sampling Time, min	Clock Time (24-hr) Clock	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O		Temperature °F					Gas Meter		Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
					Desired	Actual	Stack	Probe	Impinger	Organic Module	Oven	In	Out		
	1211	0.	Init. 879.127												
		10	—			0.9	998	426		~~300~~	336	83	83	22	
		20	—			0.9	996	828		63	342	—	—	22	
		30	959.70			0.9	997	828		63	350	89	86	22	
		40	987.2			0.9	997	827		65	358	92	88	22	
		50	015.5			0.9	997	831		65	367	94	89	21	
		60	043.7			0.9	997	828		65	373	94	90	21	
		70	070.1			0.9	999	824		62	379	94	90	21	
		80	097.0			0.9	996	823		62	382	95	95	21	
		90	122.92			0.9	995	822		62	382	95	91	21	

7602/5/81/Rev 1

* SEE SASS ANALYTICAL DATA SHEET

Comments:

Page 2 of 3

Traverse Point Number	Sampling Time, min / Clock Time (24-hr) Clock	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O		Temperature °F					Gas Meter		Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
	90	Init.		Desired	Actual	Stack	Probe	Impinger	Organic Module	Oven	In	Out		
	100				0.9	997	820		63	380	96	91	21	
	110	178.4			0.9	996	821		64	377	97	92	21	
	120	206.5			0.9	997	820		64	379	97	92	21	
	130	[illegible]			0.9	995	818		63	379	97	92	21	
	140	263.6			0.9	996	817		62	377	96	92	21	
	stop 150	289.647								—	—			
1451	160	323.1			1.9	996	740		60	330	93	91	20	
	170	356.1			1.6	996	814		62	335	98	92	20	
	180	392.5			1.6	997	817		64	348	101	93	20	
	190	426.5			1.6	995	817		65	366	102	94	20	
	200	460.7			1.6	999	818		65	371	103	94	20	
	210	494.7			1.6	1000	821		66	374	102	95	20	
	stop 220	528.422			1.6	982	822		67	374	101	94	20	
	1610 220	528.422			—	—	—		—	—	—	—	—	
	230	—			1.0	997	826		69	346	93	93	21	
	240	583.8			1.0	999	825		69	357	95	92	21	
	250	[illegible]			1.0	1000	824		65	358	96	92	21	

Run No. 1-SASS (INLET) Date 6-7-8[illegible] Sampling Location HOWARD RANCHO

Comments: 150 change SO2, drain condensate

220 Drain condensate

Page 3 of 3

Traverse Point Number	Sampling Time, min / Clock Time (24-hr) Clock	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O		Temperature °F					Gas Meter		Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
				Desired	Actual	Stack	Probe	Impinger	Organic Module	Oven	In	Out		
	250	Init. 613.2												
Stop	260	638.785			1.0	1001	826		63	370	91	92	21	
1702	~~270~~ 260	638.785			—	—	-		-	—	—	—	—	
	~~1802~~ / 270	665.8			1.0	1001	763		61	320	89	89	21	
	280	—			1.0	1001	825		62	328	92	89	21	
	290	720.1			1.0	998	823		63	351	94	89	21	
	300	746.9			1.0	1000	824		63	362	94	89	21	
	310	773.6			1.0	998	824		64	370	94	89	21	
	320	~~799~~ 800.0			1.0	998	825		64	371	92	88	21	
	330	828.1			1.0	999	829		65	373	92	86	21	
	340	—			0.9	995	822		64	373	91	88	21	
	350	879.8			0.9	994	764		64	375	89	82	21	
Stop	/ 360	1905.502			0.9	993	762		64	373	90	86	21	
	360 —	1,026.375			1.08	997					94.3	90.2	20.5	

$\frac{37.8}{35}$ 34892÷35 92.2

Run No. 1- SASS (INLET) Date 6-7-83 Sampling Location HONOR RANCHO

Comments: 260 change SO2 drain condensate

$\frac{3207}{34}$ $\frac{3065 \quad 3895}{34}$

SASS ANALYTICAL DATA

Plant So Cal / Honor Rancho Sample No. Inlet

Sampling Location Valencia, CA Run No. 1

Recovered By G. Nicoll Recovery Date 6-7-83 Run Date 6-7-83

Comments

Analyst Responsible

Calculations and Report Reviewed By Report Date

FILTERS USED

No. MV-142-330 tare = 0.99141g

CYCLONES

	Used (yes/no)	Pretared Container (No.)
10μ	No	
3μ	No	
1μ	No	

IMPINGER VOLUMES

	Initial	Final	
			+ Rinse to
First (H_2O_2)	500 ml	1685 ml	1725 mL
Second (APS + $AgNO_3$)	500 ml	1620 ml	1735 mL
Third (APS + $AgNO_3$)	500 ml	ml	
TOTALS	1500 ml	3305 ml	

Gain 1805 ml

SILICA GEL WEIGHTS

	Initial	Final
	750 g	863 g
	750 g	866 g
	750 g	843 g
TOTALS	2250 g	2572 g

Gain 322 g

CONDENSATE

TOTAL VOLUME COLLECTED 1825 ml

Volume Neat 1825 ml + Rinse to 1408 mL (0 ml Rinse added)

Volume Extracted ml

Volume CH_2Cl_2 Extract (3 x ml) ml

Extracted Condensate: pH Neat

Amount 96% HNO_3 added

pH Final

TOTAL GAIN 3952 ml

ISOKINETIC PERFORMANCE WORKSHEET & PARTICULATE CALCULATIONS

Plant [illegible] Rancho

Performed by Kaufmann

Date 6/7/83

Sample Location Inlet

Test No./Type 1 / SASS

Barometric Pressure (in. Hg)	P_b	28.55
Meter volume (std), $17.647\left(\frac{V_m}{\alpha}\right)\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right)$ $17.64\left(\frac{(1,026.375)}{(.974)}\right)\left(\frac{(28.55) + \frac{(1.08)}{13.6}}{(92.2) + 460}\right)$	$V_{m\ std}$	963.744
Volume of liquid collected (grams)	Vl_c	3952
Volume of liquid at standard condition (scf) $Vl_c \times 0.04707$	$V_{w\ std}$	186.021
Stack gas proportion of water vapor $\frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}$, $\frac{(186.021)}{(186.021) + (963.744)}$	B_{wo}	.162
Molecular weight, stack gas dry (lb/lb-mole) AVG FROM MPR $(\%\ CO_2 \times 0.44) + (\%\ O_2 \times 0.32) + (\%\ N_2 + \%\ CO \times 0.28)$ $(10.2 \times 0.44) + (0.1 \times 0.32) + (89.7 + \_\_\_ \times 0.28)$	M_d	29.64
Molecular weight, stack gas wet (lb/lb-mole) $Md(1-B_{wo}) + 18(B_{wo})$, $(29.64)(1-.162) + 18(.162)$	M_s	27.76
Absolute stack pressure (in. Hg) $P_b + \frac{P_{stack}\ (\text{in. } H_2O)}{13.6}$, $\left((28.55) + \frac{(+.15)}{13.6}\right)$ (assumed)	P_s	28.56

Temperature stack gas, average (^{0}F)	T_s	997	
Stack velocity (fps) $85.49\ (C_p)\ (\sqrt{\Delta P}_{s\ avg})\ \sqrt{\frac{T_s avg + 460}{P_s\ \ M_s}}$ $85.49\ (\underline{.79})(\sqrt{.664})^2\ \sqrt{\frac{(\underline{\quad}) + 460}{(\underline{\quad})(\underline{\quad})}}$	$V_{s(avg)}$	60.8	
Total sample time (minutes)	θ	360	
Nozzle diameter, actual (inches)	N_d	.612 ASSUMED FOR PURPOSE OF CALC.	
Percent isokinetic (%) $\frac{17.33\ (T_s + 460)(V_w\ std + V_m\ std)}{\theta\ \ V_s\ \ P_s\ \ N_d^2}$ $\frac{17.33\ (\underline{\quad} + 460)((\underline{\quad}) + (\underline{\quad}))}{(\underline{\quad\quad})(\underline{\quad\quad})(\underline{\quad\quad})(\underline{\quad\quad}^2)}$	%I	124.05	
Area of stack (ft^2) $\pi = 3.1416$ 12" DIAM $\pi r^2 \div 144$, $\pi(\underline{6''})^2 \div 144$	A_s	.785	
Stack gas volume at standard conditions (dscfm) $60\ (1 - B_{wo}) Vs_{avg}\ A_s \left(\frac{528}{T_s\ avg + 460}\right) \left(\frac{Ps}{29.92}\right)$ $60\ (1 - \underline{\quad})(\underline{\quad})(\underline{\quad})\left(\frac{528}{\underline{\quad\quad} + 460}\right) \left(\frac{(\underline{\quad})}{(29.92)}\right)$	ACFM = Q_s	2862 1/ 830	
Particulate matter concentration, dry (gr/dscf) $15.432\ \frac{M_p(grams)}{Vm_{std}}$, $15.432\ \frac{(\underline{\quad\quad})}{(\underline{\quad\quad})}$	$C_{s(std)}$	FRONT HALF RINSE FILTER	0.0022 g 0.0345 g 0.0367 g
Emission rate of particulate matter (lb/hr) $0.00857\ (Q_s)\ C_{s(std)}$, $0.00857\ (\underline{\quad\quad})(\underline{\quad\quad})$	E_p		

1/ CALC. BY L. WATERLAND

7602/5/81/Rev 1

ACUREX CORPORATION

Run 1-SASS (OUTLET)

Acurex Project No. 307735.51
Field Dates 6-6/8-83
Plant HONOR RANCHO STORAGE STA.
Sampling Location ENG 3
Sampling Date 6-7-83

FIELD CREW

Crew Chief: BRUCE C. DaROS
Testing Engineer: 1 PETR W. KAUFMANN-SASS
2 REGAN C. BEST
~~Engr~~. Technician: 1 SHERMAN A. SMITH -CM
2
3
Lab Technician: 1 GREG NICOLL
2
Process Engineer: 1 HOWARD B. MASON
2

FIELD SAMPLE REFERENCE NUMBERS:

819368
819365
819364
819367
819382
819370
819373
819371
819376
819379
819385
819394
819360

ISOKINECTIC SAMPLING WORKSHEET

Plant Honor Rancho Storage Sta.

Peformed by Kaufmann

Date 6/7/83

Sample Location Outlet

Test No./Type SASS

$$K = \frac{782.687\ (Cp)^2\ (1-B_{wo})^2\ P_s\ M_d}{K_o^2\ M_s\ P_m}$$

where: K = Contant of fixed and assumed parameters (dimensionless)

Pitot coefficient (dimensionless)	C_p	assume .85
Water vapor in the gas stream (proportion by volume)	B_{wo}	assume .2
Absolute stack gas pressure (in. Hg)	P_s	assume 15
Molecular weight, stack gas dry (lb/lb-mole)	M_d	CO_2 - 10 O_2 0.2 N_2 89.8
Orifice coefficient (dimensionless)	K_o	3.537 α - 1.016
Molecular weight, stack gas wet (lb/lb-mole) $M_d(1-B_{wo}) + 18(B_{wo})$	M_s	
Abolute meter pressure (in. Hg)	P_m	29.55
$\frac{782.687\ (\_\_\_)^2\ (1-\_\_\_)^2\ (\_\_\_)\ (\_\_\_)}{(\_\_\_)^2\ (\_\_\_)\ (\_\_\_)}$	K	36.778

ISOKINECTIC NOZZLE CALCULATION
AND
SAMPLING RATE CALCULATION

Plant Honor Rancho Storage Sta. Performed by Rostwoman
Date 6/7/83
Sample Location Outlet
Test No./Type SASS

$$N_d = \left(\frac{\Delta H\ T_s}{K\ T_m\ \Delta P}\right)^{.25}$$

where: N_d = Nozzel diameter (inches)

Average pressure differential across the orifice meter (in. H_2O)	ΔH	2.1
Temperature stack gas, average (^oF)	T_s	1050
Temperature of gas meter, average (^oF)	T_m	100
Stack gas velocity pressure (in H_2O)	ΔP	1.0
$\left(\frac{(\_\_\_)\ (\_\_\_ + 460)}{(\_\_\_)\ (\_\_\_ + 460)(\_\_\_)}\right)^{.25}$	N_d	.612

$$\Delta H = K\ (N_d)^4\ \frac{T_m}{T_s}\ (\Delta P)$$

where: ΔH = Pressure differential across the orifice meter (in H_2O)

Nozzel diameter, actual (inches)	N_d	
Temperature of gas meter (^oF)	T_m	
Temperature of stack gas (^oF)	T_s	
Stack gas velocity pressure (in H_2O)	ΔP	
$\left((\_\_\_)\ (\_\_\_)^4\ \frac{(\_\_\_ + 460)}{(\_\_\_ + 460)}\ (\_\_\_)\right)$	ΔH	
Magic number _______( )^4	$K(N_d)^4$	

Plant Honor Rancho
Date 6-7-83
Sample Location OUTLET
Sample Type SASS
Run Number 1
Operator P.W. Kaufemann
Ambient Temperature
Barometric Pressure 28.55
Static Pressure, (H_2O)
Filter Number(s)

Leak Check: Initial at ___ " Hg, ___ CFM
Final at 22 " Hg, 0.11 CFM
Pitot Leak Check: ___

Impinger Volumes Initial	Final	Net Gain
500		
20		
500		
Silica Gel		

SASS Condensate ___

Total Volume 4586 +

Nozzel Size & I.D.
Pitot Coefficient & I.D.
Assumed Moisture
Molecular Weight, Dry, (M_d)
Meter Box Number
Meter Coefficient 3.537
α Factor 1.016
K =
$K(Nd)^4 = \_\_ \times (\_\_)^4 = \_\_$
$\Delta H = K(N_d)^4 \left(\frac{Tm}{Ts}\right)$ (P)

Traverse Point Number	Sampling Time, min	Clock Time (24-hr) Clock	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O Desired	Orifice Pressure Differential (ΔH), in. H_2O Actual	Temperature °F Stack	Temperature °F Probe	Temperature °F Impinger	Temperature °F Organic Module	Temperature °F Oven	Temperature °F Gas Meter In	Temperature °F Gas Meter Out	Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
	0	~~1209~~	Init. ~~161.949~~												
	0	1240	167.318					615							
	10		203.4			1.6	1025			62	285	79	79	20	
	20		236.80			1.5	1025	654		62	262	85	83	20	
	30		268.0			1.4	1026	664		62	331	88	86	20	
	40		302.1			1.4	1036	664		65	354	90	88	20	
	50		332.6			1.4	1028	666		68	327	91	89	20	
	60		360.35			1.4	1027	668		73	340	93	91	20	
	70					1.4	1027	654		61	326	95	92	20	

7602/5/81/Rev 1

Comments:

Traverse Point Number	Sampling Time, min / Clock Time (24-hr) Clock 70	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O		Temperature °F							Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
											Gas Meter			
		Init.		Desired	Actual	Stack	Probe	Impinger	Organic Module	Oven	In	Out		
	80	429.9			1.4	1029	664		62	336	95	93	20	
	90	463.7			1.4	1029	664		64	479	96	94	20	
	100				1.4	1028	668		62	402	94	93	26	
	110	528.5			1.4	1027	660		64	366	94	93	20	
	stop 120	559.99				—	—							
1459	130	593.4			1.5	1036	305		71	313	93	92	20	
	140	623.4			1.4	1031	646		65	404	95	93	20	
	150	557.5			1.4	1032	663		62	386	97	95	20	
	160	690.1			1.4	1032	664		61	350	99	96	20	
	170	722.9			1.4	1032	665		65	329	100	97	20	
	180	755.7			1.4	1014	650		66	347	100	98	20	
	190	789.7			1.4	1024	658		64	334	100	98	20	
	200	—			1.4	1030	661		71	327	100	98	20	
	210	854.2			1.4	1031	661		65	333	99	96	20	
	220	884.6			1.4	1031	661		62	325	99	98	20	
	230				1.4	1032	664		63	323	99	97	20	
	stop													

Run No. 1-SASS (OUTLET) Date 6-7-82 Sampling Location Honor Rancho

Comments: 120 change SiO2 (condensate drained while train operates)

240 change SiO2

Traverse Point Number	Clock Time (24-hr) Clock / Sampling Time, min	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O		Temperature °F							Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
											Gas Meter			
	1702 / 230	Init. 918.875		Desired	Actual	Stack	Probe	Impinger	Organic Module	Oven	In	Out		
	240	930.4			1.4	1035	439		61	323	92	93	20	
	250	--			1.4	1031	643		60	451	92	92	20	
	260	1015.1			1.4	1031	659		60	357	94	93	[illegible]	
	270	1046.5			1.4	1030	660		62	327	94	93	20	
	280	1078.8			1.4	1032	661		65	359	94	93	20	
	290	1111.1			1.4	1029	657		69	340	94	93	20	
	300	1145.5			1.4	1032	659		60	311	92	92	20	
	310	—			1.3	1031	659		59	334	90	90	20	
stop	320	1206.956			1.3	1033	660		64	324	89	89	20	
	320 / —	1039.640			1.41	1029					93.9	92.5		

93.2

Run No. 1-SASS (OUTLET)

Date 6-7-83

31908 / 31

Sampling Location HONOR RANCHO

Comments:

2912 / 31

2867

SASS ANALYTICAL DATA

Plant So Cal / Honor Rancho **Sample No.** Outlet

Sampling Location Valencia, CA **Run No.** 1

Recovered By G. Nicoll **Recovery Date** 6-7-83 **Run Date** 6-7-83

Comments

Analyst Responsible

Calculations and Report Reviewed By **Report Date**

FILTERS USED

No. MV-142-331 0.99840g tare

CYCLONES

	Used (yes/no)	Pretared Container (No.)
10μ	No	
3μ	No	
1μ	No	

IMPINGER VOLUMES

	Initial	Final	
First (H_2O_2)	500 ml	1360 ml	+ Rinse to 1425 mL
Second (APS + $AgNO_3$)	500 ml	2465 ml	2600 mL
Third (APS + $AgNO_3$)	500 ml	\ ml	
TOTALS	1500 ml	3825 ml	Gain 2325 ml

SILICA GEL WEIGHTS

	Initial	Final	
	750 g	859 g	
	750 g	870 g	
	750 g	1282 g	overloaded
TOTALS	2250 g	3011 g	Gain 761+ g

CONDENSATE

TOTAL VOLUME COLLECTED 1500 ml

Volume Neat 1500 ml +Rinse to 1515 mL

Volume Extracted ml

Volume CH_2Cl_2 Extract (3 x ml) ml

Extracted Condensate: pH Neat

Amount 96% HNO_3 added

pH Final

TOTAL GAIN 4586+ ml

ISOKINETIC PERFORMANCE WORKSHEET & PARTICULATE CALCULATIONS

Plant Howar Rancho   Performed by B.S. DaRos
Date 6-7-83
Sample Location OUTLET
Test No./Type 1/SASS

Barometric Pressure (in. Hg)	P_b	28.55
Meter volume (std), $17.64 \left(\frac{V_m}{\alpha}\right)\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right)$ $17.6\cancel{4}5 \left(\frac{\overset{1039.640}{(\_\_\_)}}{(1.016)}\right)\left(\frac{(28.55) + \frac{(1.41)}{13.6}}{(93.2) + 460}\right)$	$V_{m\ std}$	935.475
Volume of liquid collected (grams)	Vl_c	4586
Volume of liquid at standard condition (scf) $Vl_c \times 0.04707$	$V_{w\ std}$	215.863
Stack gas proportion of water vapor $\frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}, \frac{(\_\_\_)}{(\_\_\_) + (\_\_\_)}$	B_{wo}	0.187
Molecular weight, stack gas dry (lb/lb-mole) (% CO_2 x 0.44) + (% O_2 x 0.32) + (% N_2 + % CO x 0.28) (10.2 x 0.44) + (0.1 x 0.32) + (89.7 + ___ x 0.28)	M_d	29.636
Molecular weight, stack gas wet (lb/lb-mole) $Md(1-B_{wo}) + 18(B_{wo})$, (29.636(1-.187) + 18(.187)	M_s	27.45
Absolute stack pressure (in. Hg) $P_b + \frac{P_{stack}\ (in.\ H_2O)}{13.6}, (28.55) + \frac{(.15)}{13.6}$	P_s	28.56

7602/5/81/Rev 1

Temperature stack gas, average (^{O}F)	T_s	1029
Stack velocity (fps) $85.49\ (C_p)\ (\sqrt{\Delta P_{s\ avg}})\ \sqrt{\frac{T_s avg + 460}{P_s \quad M_s}}$ $85.49\ (\underline{.79})(\sqrt{.644})^2\ \sqrt{\frac{(\underline{1029}) + 460}{(\underline{28.56})(\underline{27.45})}}$	$V_{s(avg)}$	59.94
Total sample time (minutes)	θ	320
Nozzle diameter, actual (inches)	N_d	.612
Percent isokinetic (%) $\frac{17.33\ (T_s + 460)(V_w\ std + V_m\ std)}{\theta \quad V_s \quad P_s \quad N_d^2}$ $\frac{17.33\ (\_\_\_ + 460)((\_\_\_) + (\_\_\_))}{(\_\_\_)(\_\_\_)(\_\_\_)(\_\_\_^2)}$	%I	144.806
Area of stack (ft^2) $\pi = 3.1416$ $\pi r^2 \div 144$, $\pi(\underline{6"})^2 \div 144$	A_s	.785
Stack gas volume at standard conditions (dscfm) $60\ (1 - B_{wo}) Vs_{avg}\ A_s \left(\frac{528}{T_s\ avg + 460}\right) \left(\frac{Ps}{29.92}\right)$ $60\ (1 - \_\_\_)(\_\_\_)(\_\_\_)\left(\frac{528}{\_\_\_ + 460}\right) \left(\frac{(\_\_\_)}{(29.92)}\right)$	ACFM Q_s	2,823 776
Particulate matter concentration, dry (gr/dscf) $15.432\ \frac{M_p (grams)}{Vm_{std}}$, $15.432\ \frac{(\_\_\_)}{(\_\_\_)}$	$C_{s(std)}$	FRONT HALF RINSE FILTER
Emission rate of particulate matter (lb/hr) $0.00857\ (Q_s)\ C_{s(std)}$, $0.00857\ (\_\_\_)(\_\_\_)$	E_p	

0.0034g
$\underline{0.0342}$
0.0376

7602/5/81/Rev 1

3.3 OPERATING DATA TABLES FOR NH_3 SAMPLING TRAIN

ACUREX CORPORATION

Run 1-NH$_3$ (INLET)

Acurex Project No. 307735.51

Field Dates 6-6/8-83

Plant HONOR RANCHO STORAGE STA.

Sampling Location ENG 3

Sampling Date 6-7-83

FIELD CREW

Crew Chief: BRUCE C. DaROS

Testing Engineer: 1 " "

2 REGAN C. BAST

C.M. ~~Engr.~~ Technician: 1 SHERMAN A. SMITH

2

3

Lab Technician: 1 GREG NICOLL

2

Process Engineer: 1 HOWARD B. MASON

2

FIELD SAMPLE REFERENCE NUMBERS:

~~819386~~ VOID

819359

819387

FIELD DATA

Page 1 of 1

Plant HONOR RANCHO,
Date 6-7-83
Sample Location INLET
Sample Type NH_3
Run Number 1
Operator R.C. DuBos
Ambient Temperature
Barometric Pressure 28.62 @ 1315
Static Pressure, (H_2O)
Filter Number(s) N/A

Leak Check: Initial at 12 " Hg., .004 CFM
Final at 5 " Hg., .003 CFM
Pitot Leak Check:

+64.0 RINSE

Impinger Volumes Initial	Final	Net Gain
100		
100	273	23.0
MT		

Silica Gel Initial	Final	Net Gain
591.4	597.0	5.6

SASS Condensate
Total Volume 78.6

Probe Length and Type SS
Nozzel Size & I.D. N/A
Pitot Coefficient & I.D. N/A
Assumed Moisture
Molecular Weight, Dry, (M_d)
Meter Box Number D556 NAPP
Meter Coefficient
α Factor .9995
K =
$K(Nd)^4 = \_\_\_ \times (\_\_\_)^4 = \_\_\_$
$\Delta H = K(M_d)^4 \left(\frac{Tm}{Ts}\right) (P)$

Traverse Point Number	Sampling Time, min	Clock Time (24-hr) Clock	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O Desired	Orifice Pressure Differential (ΔH), in. H_2O Actual	Temperature °F Stack	Temperature °F Probe	Temperature °F Impinger	Temperature °F Organic Module	Temperature °F Oven	Temperature °F Gas Meter In	Temperature °F Gas Meter Out	Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
	0	1250	Init. 278.622												
	10	1300	284.42			1.0	998					62	68	2.0	
	20	1310	289.72			1.0	997					65	63	2.0	
	30	1320	295.450			1.0	998					68	62	2.0	
	30	—	16.828				997.3					64.7		2.0	

7602/5/81/Rev 1

Comments:

ISOKINETIC PERFORMANCE WORKSHEET & PARTICULATE CALCULATIONS

Plant HONOR RANCHO
Performed by DaRos
Date 6-7-83
Sample Location INLET
Test No./Type 1-NH3

Barometric Pressure (in. Hg)	P_b	28.62
Meter volume (std), $17.64 \left(\frac{V_m}{\alpha}\right)\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right)$ $17.64 \left(\frac{(16.828)}{(.4995)}\right)\left(\frac{(28.62) + \frac{(\_\_\_)}{13.6}}{(64.7) + 460}\right)$	$V_{m\ std}$	16.251
Volume of liquid collected (grams)	Vl_c	78.6
Volume of liquid at standard condition (scf) $Vl_c \times 0.04707$	$V_{w\ std}$	3.700
Stack gas proportion of water vapor $\frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}, \frac{(3.7)}{(3.7) + (16.251)}$	B_{wo}	0.185
Molecular weight, stack gas dry (lb/lb-mole) $(\%\ CO_2 \times 0.44) + (\%\ O_2 \times 0.32) + (\%\ N_2 + \%\ CO \times 0.28)$ $(10.2 \times 0.44) + (0.1 \times 0.32) + (89.7 + \_\_\_ \times 0.28)$	M_d	29.636
Molecular weight, stack gas wet (lb/lb-mole) $Md(1-B_{wo}) + 18(B_{wo}), (29.636)(1-.185) + 18(.185)$	M_s	28.63
Absolute stack pressure (in. Hg) $P_b + \frac{P_{stack}\ (\text{in. } H_2O)}{13.6}, (28.62) + \frac{(.15)}{13.6}$	P_s	28.63

Temperature stack gas, average (^{o}F)	T_s	997.3
Stack velocity (fps) $85.49\,(C_p)\,(\sqrt{\Delta P}_{s\ avg})\,\sqrt{\frac{T_s avg + 460}{P_s \quad M_s}}$ $85.49\,(\_\_\_)(\sqrt{\quad\quad})\,\sqrt{\frac{(\_\_\_) + 460}{(\_\_\_)(\_\_\_)}}$	$V_{s(avg)}$	
Total sample time (minutes)	θ	30
Nozzle diameter, actual (inches)	N_d	N/A
Percent isokinetic (%) $\frac{17.33\,(T_s + 460)(V_w\ std + V_m\ std)}{\theta \quad V_s \quad P_s \quad N_d^2}$ $\frac{17.33\,(\_\_\_ + 460)((\_\_\_) + (\_\_\_))}{(\_\_\_)(\_\_\_)(\_\_\_)(\_\_\_^2)}$	%I	N/A
Area of stack (ft^2) $\pi = 3.1416$ $\pi r^2 \div 144$, $\pi(\_\_\_)^2 \div 144$	A_s	
Stack gas volume at standard conditions (dscfm) $60\,(1 - B_{wo})Vs_{avg}\,A_s\left(\frac{528}{T_s\ avg + 460}\right)\left(\frac{Ps}{29.92}\right)$ $60\,(1 - \_\_\_)(\_\_\_)(\_\_\_)\left(\frac{528}{\_\_\_ + 460}\right)\left(\frac{(\_\_\_)}{(29.92)}\right)$	Q_s	
Particulate matter concentration, dry (gr/dscf) $15.432\,\frac{M_p(grams)}{Vm_{std}}$, $15.432\,\frac{(\_\_\_)}{(\_\_\_)}$	$C_{s(std)}$	
Emission rate of particulate matter (lb/hr) $0.00857\,(Q_s)\,C_{s(std)}$, $0.00857\,(\_\_\_)(\_\_\_)$	E_p	

7602/5/81/Rev 1

ACUREX CORPORATION

Run 1-NH_3 (OUTLET)

Acurex Project No. 307735.51

Field Dates 6-6/8-83

Plant HONOR RANCHO STORAGE STA.

Sampling Location ENG 3

Sampling Date 6-7-83

FIELD CREW

Crew Chief: BRUCE C. DaROS

Testing Engineer: 1 " "

2 REGAN C. BEST

C.M. ~~Engr.~~ Technician: 1 SHERMAN A. SMITH

2

3

Lab Technician: 1 GREG NICOL

2

Process Engineer: 1 HOWARD B. MASON

2

FIELD SAMPLE REFERENCE NUMBERS:

819388

Page 1 of 1

FIELD DATA

Plant Howard Rancho
Date 6-7-83
Sample Location OUTLET
Sample Type NH_3
Run Number 1
Operator B.C. Del Ros
Ambient Temperature 85°F
Barometric Pressure 28.62
Static Pressure, (H_2O)
Filter Number(s) N/A

Leak Check: Initial at 17" Hg, .006 CFM
Final at 6" Hg, .200 CFM
Pitot Leak Check: N/A

r 33 Aimsr.

Impinger Volumes

Initial	Final	Net Gain
100		
100	263.	63
MT		
Silica Gel		
594.6	598.5	3.9

SASS Condensate
Total Volume 66.9

Probe Length and Type SS
Nozzel Size & I.D. N/A
Pitot Coefficient & I.D. N/A
Assumed Moisture
Molecular Weight, Dry, (M_d)
Meter Box Number D555 (NAPP)
Meter Coefficient
α Factor .9908
K =
$K(Nd)^4$ = ___ x (___)^4 = ___
$\Delta H = K(N_d)^4 \left(\frac{Tm}{Ts}\right) (P)$

Traverse Point Number	Sampling Time, min / Clock Time (24-hr) Clock	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O		Temperature °F							Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
				Desired	Actual	Stack	Probe	Impinger	Organic Module	Oven	Gas Meter In	Gas Meter Out		
	0.0 / 1250	Init 929.707												
	5.0	932.79			1.1	1025					76	77	4	
	10.0	935.83			1.1	—					75	76	4	
	15.0	938.81			1.1	—					81	80	4	
	20.0	941.80			1.1	1026					83	83	4	
	25.0	944.75			1.1	1026					81	81	4	
	30.0 End	947.737												
	30 / —	18.03			1.1	1025.5					79.6		4	

7602/5/81/Rev 1

Comments:

ISOKINETIC PERFORMANCE WORKSHEET & PARTICULATE CALCULATIONS

Plant HONOR RANCHO

Performed by DuBos

Date 6-7-83

Sample Location OUTLET

Test No./Type 1-NH3

Barometric Pressure (in. Hg)	P_b	28.62
Meter volume (std), $17.64 \left(\frac{V_m}{\alpha}\right)\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right)$ $17.64 \left(\frac{(18.03)}{(.9908)}\right)\left(\frac{(28.62) + \frac{(1.1)}{13.6}}{(79.6) + 460}\right)$	$V_{m\ std}$	17.084
Volume of liquid collected (grams)	Vl_c	66.9
Volume of liquid at standard condition (scf) $Vl_c \times 0.04707$	$V_{w\ std}$	3.149
Stack gas proportion of water vapor $\frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}$, $\frac{(3.149)}{(3.149) + (17.084)}$	B_{wo}	0.156
Molecular weight, stack gas dry (lb/lb-mole) (% CO_2 x 0.44) + (% O_2 x 0.32) + (% N_2 + % CO x 0.28) (10.2 x 0.44) + (.1 x 0.32) + (89.7 + ____ x 0.28)	M_d	29.636
Molecular weight, stack gas wet (lb/lb-mole) $Md(1-B_{wo}) + 18(B_{wo})$, (29.636)(1-.156) + 18(.156)	M_s	27.82
Absolute stack pressure (in. Hg) $P_b + \frac{P_{stack}\ (\text{in. } H_2O)}{13.6}$, $(28.62) + \frac{(.15)}{13.6}$	P_s	28.63

7602/5/81/Rev 1

Temperature stack gas, average (^{o}F)	T_s	1025.5
Stack velocity (fps) $85.49\ (C_p)\ (\sqrt{\Delta P_{s\ avg}})\ \sqrt{\frac{T_s avg + 460}{P_s\ \ M_s}}$ $85.49\ (\_\_\_)(\sqrt{\quad})\ \sqrt{\frac{(\_\_\_) + 460}{(\_\_\_)(\_\_\_)}}$	$V_{s(avg)}$	
Total sample time (minutes)	θ	30
Nozzle diameter, actual (inches)	N_d	N/A
Percent isokinetic (%) $\frac{17.33\ (T_s + 460)(V_w\ std + V_m\ std)}{\theta\ \ V_s\ \ P_s\ \ N_d^2}$ $\frac{17.33\ (\_\_\_ + 460)((\_\_\_) + (\_\_\_))}{(\_\_\_)(\_\_\_)(\_\_\_)(^2\_\_\_)}$	%I	N/A
Area of stack (ft^2) π= 3.1416 $\pi r^2 \div 144$, $\pi(\_\_\_)^2 \div 144$	A_s	
Stack gas volume at standard conditions (dscfm) $60\ (1 - B_{wo})Vs_{avg}\ A_s \left(\frac{528}{T_s\ avg + 460}\right) \left(\frac{Ps}{29.92}\right)$ $60\ (1 - \_\_\_)(\_\_\_)(\_\_\_)\left(\frac{528}{\_\_\_ + 460}\right) \left(\frac{(\_\_\_)}{(29.92)}\right)$	Q_s	
Particulate matter concentration, dry (gr/dscf) $15.432\ \frac{M_p(grams)}{Vm_{std}}$, $15.432\ \frac{(\_\_\_)}{(\_\_\_)}$	$C_{s(std)}$	
Emission rate of particulate matter (lb/hr) $0.00857\ (Q_s)\ C_{s(std)}$, $0.00857\ (\_\_\_)(\_\_\_)$	E_p	

ACUREX CORPORATION

Run 2-NH_3 (OUTLET)

Acurex Project No. 307735.51
Field Dates 6-6/8-83
Plant HONOR RANCHO STORAGE STA.
Sampling Location ENG 3
Sampling Date 6-7-83

FIELD CREW

Crew Chief:		BRUCE C. DAROS
Testing Engineer:	1	" "
	2	REGAN C. BEST
~~Engr.~~ CM Technician:	1	SHERMAN A. SMITH
	2	
	3	
Lab Technician:	1	GREG NICOLL
	2	
Process Engineer:	1	HOWARD B. MASON
	2	

FIELD SAMPLE REFERENCE NUMBERS:

819384

FIELD DATA

Page 1 of 1

Plant [illegible]
Date 6-7-83
Sample Location Engine 3 Outlet
Sample Type NH_3
Run Number 2
Operator Bost
Ambient Temperature ______
Barometric Pressure 28.62
Static Pressure, (H_2O) ______
Filter Number(s) N/A

Leak Check: Initial at 6 " Hg, .002 CFM
Final at 27" Hg, .002 CFM
Pitot Leak Check: ______

+30 mL Rinse

Impinger Volumes Initial	Final	Net Gain
100		
100	287	87
ø		
Silica Gel 598.5	602.7	4.2

SASS Condensate ______
Total Volume 91.2

Probe Length and Type ______
Nozzel Size & I.D. ______
Pitot Coefficient & I.D. ______
Assumed Moisture ______
Molecular Weight, Dry, (M_d) ______
Meter Box Number D5S5 (NAPP)
Meter Coefficient ______
@ Factor .9908
K = ______
$K(Md)^4$ = ___ x (___)^4 = ___
$\Delta H = K(M_d)^4 \left(\frac{Tm}{TS}\right)$ (P)

Traverse Point Number	Sampling Time, min	Clock Time (24-hr) Clock	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O Desired	Orifice Pressure Differential (ΔH), in. H_2O Actual	Temperature °F Stack	Temperature °F Probe	Temperature °F Impinger	Temperature °F Organic Module	Temperature °F Oven	Temperature °F Gas Meter In	Temperature °F Gas Meter Out	Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
		1650	Init. 967.259												
	0.0		967.259			1.1	1020					85	85	4	
	5.0		970.38			1.1	1020					87	86	4	
	10.0		973.46			1.1	1027					87	86	4	
	15.0		976.48			1.1	1029					87	86	4	
	20.0		979.49			1.1	1030					88	87	4	
	25.0		982.51			1.1	1030					88	87	4	
	30.0		985.529												
	30	—	18.27			1.1	1026					86.6		4	

7602/5/81/Rev 1

Comments:

ISOKINETIC PERFORMANCE WORKSHEET & PARTICULATE CALCULATIONS

Plant HONOR RANCHO

Performed by Dna Ros

Date 6-7-83

Sample Location OUTLET

Test No./Type 2-NH_3

Barometric Pressure (in. Hg)	P_b	28.62
Meter volume (std), $17.64 \left(\frac{V_m}{\alpha}\right)\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right)$ $17.64 \left(\frac{(18.27)}{(.9908)}\right)\left(\frac{(28.62) + \frac{(1.1)}{13.6}}{(86.6) + 460}\right)$	$V_{m\ std}$	17.089
Volume of liquid collected (grams)	Vl_c	91.2
Volume of liquid at standard condition (scf) $Vl_c \times 0.04707$	$V_{w\ std}$	4.293
Stack gas proportion of water vapor $\frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}, \frac{(4.293)}{(4.293) + (17.089)}$	B_{wo}	0.201
Molecular weight, stack gas dry (lb/lb-mole) $(\%\ CO_2 \times 0.44) + (\%\ O_2 \times 0.32) + (\%\ N_2 + \%\ CO \times 0.28)$ $(10.2 \times 0.44) + (.1 \times 0.32) + (89.7 + \_\_\_ \times 0.28)$	M_d	29.636
Molecular weight, stack gas wet (lb/lb-mole) $Md(1-B_{wo}) + 18(B_{wo}), (29.636)(1-.201) + 18(.201)$	M_s	27.30
Absolute stack pressure (in. Hg) $P_b + \frac{P_{stack}\ (\text{in. } H_2O)}{13.6}, 28.62) + \frac{(.15)}{13.6}$	P_s	28.63

Temperature stack gas, average (^{o}F)	T_s	1026
Stack velocity (fps) $85.49\ (C_p)\ (\sqrt{\Delta P_{s\ avg}})\ \sqrt{\frac{T_s avg + 460}{P_s \quad M_s}}$ $85.49\ (\_\_\_)(\qquad)\ \sqrt{\frac{(\_\_\_) + 460}{(\_\_\_)(\_\_\_)}}$	$V_{s(avg)}$	
Total sample time (minutes)	θ	30
Nozzle diameter, actual (inches)	N_d	N/A
Percent isokinetic (%) $\frac{17.33\ (T_s + 460)(V_w\ std + V_m\ std)}{\theta \quad V_s \quad P_s \quad N_d^2}$ $\frac{17.33\ (\_\_\_ + 460)((\_\_\_) + (\_\_\_))}{(\_\_\_)(\_\_\_)(\_\_\_)(\_\_\_)^2}$	%I	N/A
Area of stack (ft^2) $\pi = 3.1416$ $\pi r^2 \div 144$, $\pi(\_\_\_)^2 \div 144$	A_s	
Stack gas volume at standard conditions (dscfm) $60\ (1 - B_{wo}) Vs_{avg}\ A_s \left(\frac{528}{T_s\ avg + 460}\right) \left(\frac{Ps}{29.92}\right)$ $60\ (1 - \_\_\_)(\_\_\_)(\_\_\_)\left(\frac{528}{\_\_\_ + 460}\right) \left(\frac{(\_\_\_)}{(29.92)}\right)$	Q_s	
Particulate matter concentration, dry (gr/dscf) $15.432\ \frac{M_p(grams)}{Vm_{std}}$, $15.432\ \frac{(\_\_\_)}{(\_\_\_)}$	$C_{s(std)}$	
Emission rate of particulate matter (lb/hr) $0.00857\ (Q_s)\ C_{s(std)}$, $0.00857\ (\_\_\_)(\_\_\_)$	E_p	

3.4 OPERATING DATA TABLES FOR HCN SAMPLING TRAIN

ACUREX CORPORATION

Run 1 - HCN (INLET)

Acurex Project No. 307735.51

Field Dates 6-6/8-83

Plant HONOR RANCHO STORAGE STA.

Sampling Location ENG 3

Sampling Date 6-7-83

FIELD CREW

Crew Chief: BRUCE C. DuROS

Testing Engineer: 1 " "

2 REGAN C. BEST

CM ~~Engr~~. Technician: 1 SHERMAN A. SMITH

2

3

Lab Technician: 1 GREG NICOLL

2

Process Engineer: 1 HOWARD B. MASON

2

FIELD SAMPLE REFERENCE NUMBERS:

~~819389~~ VOID

819356

819390

FIELD DATA

Page 1 of 1

Plant Honor Rancho
Date 6-7-83
Sample Location INLET
Sample Type HCN
Run Number 1
Operator B.C. DaRos
Ambient Temperature ~76°F
Barometric Pressure 28.62
Static Pressure, (H_2O)
Filter Number(s) N/A

Leak Check: Initial at ~~.002~~ 6 " Hg, .002 CFM
Final at 6 " Hg, .002 CFM
Pitot Leak Check: N/A

+ 64.0 Rinse

Impinger Volumes Initial	Final	Net Gain
100		
100	276	76
Silica Gel		
585.0	591.4	6.4

SASS Condensate

Total Volume 82.4

Probe Length and Type SS
Nozzel Size & I.D. N/A
Pitot Coefficient & I.D. N/A
Assumed Moisture
Molecular Weight, Dry, (M_d)
Meter Box Number DS56
Meter Coefficient
α Factor .9995
K =
$K(Nd)^4$ = ___ x (___)^4 = ___
$\Delta H = K(N_d)^4 \left(\frac{Tm}{Ts}\right)$ (P)

Traverse Point Numbe:	Sampling Time, min	Clock Time (24-hr) Clock	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O		Temperature °F							Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
					Desired	Actual	Stack	Probe	Impinger	Organic Module	Oven	Gas Meter In	Gas Meter Out		
	0	1450	Init. 295.854												
	10		301.61			1.0	996					69	71	2.5	
	20		307.22			1.0	997					71	70	2.5	
	30		313.170			1.0	996					71	71	2.5	
	30	—	17.316			1.0	996.3					70.5		2.5	

7602/5/81/Rev 1

Comments:

ISOKINETIC PERFORMANCE WORKSHEET & PARTICULATE CALCULATIONS

Plant Howor Rancho
Performed by DaRos

Date 6-7-83

Sample Location INLET

Test No./Type 1-HCN

Barometric Pressure (in. Hg)	P_b	28.62
Meter volume (std), $17.64 \left(\frac{V_m}{\alpha}\right)\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right)$ $17.64 \left(\frac{(17.316)}{(.9995)}\right)\left(\frac{(28.62) + \frac{(1.0)}{13.6}}{(70.5) + 460}\right)$	$V_{m\ std}$	16.539
Volume of liquid collected (grams)	Vl_c	82.4
Volume of liquid at standard condition (scf) $Vl_c \times 0.04707$	$V_{w\ std}$	3.879
Stack gas proportion of water vapor $\frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}$, $\frac{(.190)}{(.190) + (16.539)}$	B_{wo}	0.190
Molecular weight, stack gas dry (lb/lb-mole) $(\%\ CO_2 \times 0.44) + (\%\ O_2 \times 0.32) + (\%\ N_2 + \%\ CO \times 0.28)$ $(10.2 \times 0.44) + (0.1 \times 0.32) + (89.7 + \_\_\_ \times 0.28)$	M_d	29.636
Molecular weight, stack gas wet (lb/lb-mole) $Md(1-B_{wo}) + 18(B_{wo})$, $(29.636)(1-.190) + 18(.190)$	M_s	27.43
Absolute stack pressure (in. Hg) $P_b + \frac{P_{stack}\ (\text{in. } H_2O)}{13.6}$, $(28.62) + \frac{(.15)}{13.6}$	P_s	28.63

7602/5/81/Rev 1

Temperature stack gas, average (^oF)	T_s	996
Stack velocity (fps) $85.49\ (C_p)\ (\sqrt{\Delta P_{s\ avg}})\ \sqrt{\frac{T_s avg + 460}{P_s \quad M_s}}$ $85.49\ (\_\_\_)(\sqrt{\quad})\ \sqrt{\frac{(\_\_\_) + 460}{(\_\_\_)(\_\_\_)}}$	$V_{s(avg)}$	
Total sample time (minutes)	θ	30
Nozzle diameter, actual (inches)	N_d	N/A
Percent isokinetic (%) $\frac{17.33\ (T_s + 460)(V_w\ std + V_m\ std)}{\theta \quad V_s \quad P_s \quad N_d^2}$ $\frac{17.33\ (\_\_\_ + 460)((\_\_\_) + (\_\_\_))}{(\_\_\_)(\_\_\_)(\_\_\_)(^2\_\_\_)}$	%I	N/A
Area of stack (ft^2) $\pi = 3.1416$ $\pi r^2 \div 144$, $\pi(\_\_\_)^2 \div 144$	A_s	
Stack gas volume at standard conditions (dscfm) $60\ (1 - B_{wo}) Vs_{avg}\ A_s \left(\frac{528}{T_s\ avg + 460}\right) \left(\frac{Ps}{29.92}\right)$ $60\ (1 - \_\_)(\_\_)(\_\_)\left(\frac{528}{\_\_\_ + 460}\right) \left(\frac{(\_\_)}{(29.92)}\right)$	Q_s	
Particulate matter concentration, dry (gr/dscf) $15.432\ \frac{M_p (grams)}{Vm_{std}}$, $15.432\ \frac{(\_\_\_)}{(\_\_\_)}$	$C_{s(std)}$	
Emission rate of particulate matter (lb/hr) $0.00857\ (Q_s)\ C_{s_{(std)}}$, $0.00857\ (\_\_\_)(\_\_\_)$	E_p	

ACUREX CORPORATION

Run 1- HCN (OUTLET)

Acurex Project No. 307735.51

Field Dates 6-6/8-83

Plant HONOR RANCHO STORAGE STN.

Sampling Location ENG 3

Sampling Date 6-7-83

FIELD CREW

Crew Chief: BRUCE C. DaROS

Testing Engineer: 1 " "

2 REGAN C. BEST

C.M. ~~Engr.~~ Technician: 1 SHERMAN A. SMITH

2

3

Lab Technician: 1 GREG NICOLL

2

Process Engineer: 1 HOWARD B. MASON

2

FIELD SAMPLE REFERENCE NUMBERS:

819391

FIELD DATA

Page 1 of 1

Plant HONOR RANCHO
Date 6-7-83
Sample Location OUTLET
Sample Type HCN
Run Number 1
Operator R.C. DaRos
Ambient Temperature 78°F
Barometric Pressure 28.62
Static Pressure, (H_2O)
Filter Number(s) N/A

Leak Check: Initial at 6 " Hg. .002 CFM
Final at 6 " Hg. .005 CFM
Pitot Leak Check: N/A

+74.0 RINSE

Impinger Volumes Initial	Final	Net Gain
~~100~~		
~~100~~	282	82
~~0~~		
Silica Gel		
570.0	578.2	8.2

SASS Condensate

Total Volume 90.2

Probe Length and Type SS
Nozzel Size & I.D. N/A
Pitot Coefficient & I.D. N/A
Assumed Moisture
Molecular Weight, Dry, (M_d)
Meter Box Number ΔSSS
Meter Coefficient
α Factor .9908
K =
$K(Nd)^4$ = ___ x (___)^4 = ___
$\Delta H = K(N_d)^4 \left(\frac{Tm}{Ts}\right)$ (P)

Traverse Point Number	Sampling Time, min / Clock Time (24-hr) Clock	Gas Meter Reading (V_m), ft 3	Velocity Head (ΔP_s), in. H_2O	Orifice Pressure Differential (ΔH), in. H_2O		Temperature °F					Gas Meter		Pump Vacuum in. Hg	Avg. $\sqrt{\Delta P}$
				Desired	Actual	Stack	Probe	Impinger	Organic Module	Oven	In	Out		
	0.0 / 1450	Init. 948.926												
	0.0	948.926			1.1	1031					84	88	3	
	5.0	952.06			1.1						86	87	3	
	10.0	955.90			1.1						87	86	3	
	15.0	958.17			1.1						88	87	3	
	20.0	961.22			1.1	1032					89	88	3	
	25.0	944.18			1.1	1037					90	89	3	
	30.0 End	967.195												
	30 / —	18.269			1.1	1032					87.4		3	

7602/5/81/Rev 1

Comments:

ISOKINETIC PERFORMANCE WORKSHEET & PARTICULATE CALCULATIONS

Plant HONOR RANCHO

Performed by DmRos

Date 6-7-83

Sample Location OUTLET

Test No./Type 1-HCN

Barometric Pressure (in. Hg)	P_b	28.62
Meter volume (std), $17.64 \left(\frac{V_m}{\alpha}\right)\left(\frac{P_b + \frac{\Delta H}{13.6}}{T_m + 460}\right)$ $17.64 \left(\frac{(18.269)}{(.9908)}\right)\left(\frac{(28.62) + \frac{(1.1)}{13.6}}{(87.4) + 460}\right)$	$V_{m\ std}$	17.063
Volume of liquid collected (grams)	Vl_c	90.2
Volume of liquid at standard condition (scf) $Vl_c \times 0.04707$	$V_{w\ std}$	4.246
Stack gas proportion of water vapor $\frac{V_{w\ std}}{V_{w\ std} + V_{m\ std}}, \frac{(4.206)}{(4.206) + (17.063)}$	B_{wo}	0.199
Molecular weight, stack gas dry (lb/lb-mole) $(\%\ CO_2 \times 0.44) + (\%\ O_2 \times 0.32) + (\%\ N_2 + \%\ CO \times 0.28)$ $(10.2 \times 0.44) + (.1 \times 0.32) + (89.7 + \_\_\_ \times 0.28)$	M_d	29.636
Molecular weight, stack gas wet (lb/lb-mole) $Md(1-B_{wo}) + 18(B_{wo}), (29.636)(1-.199) + 18(.199)$	M_s	27.32
Absolute stack pressure (in. Hg) $P_b + \frac{P_{stack}\ (\text{in. } H_2O)}{13.6}, (28.62) + \frac{(.15)}{13.6}$	P_s	28.63

7602/5/81/Rev 1

Temperature stack gas, average (^oF)	T_s	1032
Stack velocity (fps) $85.49\,(C_p)\,(\sqrt{\Delta P_{s\ avg}})\,\sqrt{\frac{T_s avg + 460}{P_s \quad M_s}}$ $85.49\,(\underline{\quad})(\sqrt{\underline{\quad}})\,\sqrt{\frac{(\underline{\quad}) + 460}{(\underline{\quad})(\underline{\quad})}}$	$V_{s(avg)}$	
Total sample time (minutes)	θ	30
Nozzle diameter, actual (inches)	N_d	N/A
Percent isokinetic (%) $\frac{17.33\,(T_s + 460)(V_w\ std + V_m\ std)}{\theta \quad V_s \quad P_s \quad N_d^2}$ $\frac{17.33\,(\underline{\quad} + 460)((\underline{\quad}) + (\underline{\quad}))}{(\underline{\quad})(\underline{\quad})(\underline{\quad})(\underline{\quad}^2)}$	%I	N/A
Area of stack (ft^2) $\pi = 3.1416$ $\pi r^2 \div 144$, $\pi(\underline{\quad})^2 \div 144$	A_s	
Stack gas volume at standard conditions (dscfm) $60\,(1 - B_{wo})Vs_{avg}\,A_s\left(\frac{528}{T_s\ avg + 460}\right)\left(\frac{Ps}{29.92}\right)$ $60\,(1 - \underline{\quad})(\underline{\quad})(\underline{\quad})\left(\frac{528}{\underline{\quad} + 460}\right)\left(\frac{(\underline{\quad})}{(29.92)}\right)$	Q_s	
Particulate matter concentration, dry (gr/dscf) $15.432\,\frac{M_p(grams)}{Vm_{std}}$, $15.432\,\frac{(\underline{\quad})}{(\underline{\quad})}$	$C_{s(std)}$	
Emission rate of particulate matter (lb/hr) $0.00857\,(Q_s)\,C_{s(std)}$, $0.00857\,(\underline{\quad})(\underline{\quad})$	E_p	

SECTION 4

ANALYTICAL RESULTS

4.1 AMMONIA, CYANIDE, AND N_2O ANALYSES AND PARTICULATE WEIGHTS

4.2 TRACE ELEMENT ANALYSIS RESULTS

4.3 TOTAL CHROMATOGRAPHABLE ORGANICS (TCO), GRAVIMETRIC ORGANICS (GRAV), INFRARED (IR) SPECTRA, AND GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS) OF TOTAL SAMPLE EXTRACTS

4.4 LIQUID CHROMATOGRAPHY (LC) SEPARATION OF THE INLET XAD-2 EXTRACT WITH TCO, GRAV, AND IR ANALYSIS OF LC FRACTIONS

4.5 BIOASSAY RESULTS

4.6 NATURAL GAS FUEL ANALYSIS

4.1 AMMONIA, CYANIDE, AND N_2O ANALYSES AND PARTICULATE WEIGHTS

ACUREX Corporation

Energy & Environmental Division

Acurex

August 30, 1983
Acurex ID#: 8308-039
Client PO#: 307736.52

Attention: Larry Waterland

Subject: Honor Rancho Ammonia and Cyanide Determinations; received 8/24/83.

The above samples were analyzed for ammonia by EPA Method 350.2 (colorimetric) or for total cyanide by EPA Method 335.2 (spectrophotometric). Results are presented below.

Sample #	Description	Volume, mL ± 5 mL	Ammonia, mg as NH_3	Total Cyanide, mg
819359	NH_3 Blank	305	0.02	--
819387	NH_3 Inlet	340	10	--
819388	NH_3 Outlet	300	150	--
819384	NH_3 Outlet, Run #2	310	180	--
819356	HCN Blank	380	--	<0.002
819390	HCN Inlet	340	--	0.006
819391	HCN Outlet	360	--	2.8

Prepared by: Stephen Guinnane
Stephen Guinnane
Analyst

Approved by: Greg Nicoll
Greg Nicoll
Manager, Inorganic Chemistry

SG/GN/ats

555 Clyde Avenue, P.O. Box 7555, Mountain View, CA 94039 (415) 964-3200 Telex: 34-6391 TWX: 910-7796593

ACUREX Corporation

Energy & Environmental Division

Acurex/ES

July 26, 1983
Acurex ID#: 8306-068
Client PO#: 307736.52
Page 1 of 1

Attention: Larry Waterland

Subject: Analysis of Four Gas Bombs for N_2O by GC/ECD.

The above referenced samples were analyzed by GC/ECD using the CMEA procedure in Section 9 except for the following: the column used was a 10' x 1/8" stainless steel column packed with 80/100 mesh Chromosorb 101; the flow was 20 ml/min, and the temperature was 45°C isothermal.

Results are listed in the table below.

Sample ID #	Test #	ppm N_2O
819350	1	46
819351	2	15
819352	3	150
819353	4	54

If you have any questions, please call.

Prepared by: William G. Hellier
William G. Hellier
Staff Chemist

Approved by: Viorica Lopez-Avila
Viorica Lopez-Avila, Ph.D.
Technical Director

WGH/VLA/ats

555 Clyde Avenue, P.O. Box 7555, Mountain View, CA 94039 (415) 964-3200 Telex: 34-6391 TWX: 910-7796593

ACUREX Corporation
ANALYSIS LABORATORIES

DATA REPORTING FORM

CUSTOMER CMEA
DATE November 14, 1983
CUSTOMER CONTRACT NO. 307736.52
ACUREX CONTRACT NO. 8306-050
RESULTS REPORT TO L. Waterland
TELEPHONE
ADDRESS
Honor Rancho

SAMPLE ID (CUSTOMER)	365	366	367	363	364	378	379	381	382	
SAMPLE ID (LAB)	Filter Blank	Filter In	Filter Out	Probe In	Probe Out	Imp 1 In	Imp 1 Out	Imp 2 & 3 In	Imp 2 & 3 Out	
PARAMETER										UNITS
Filter and ash weight	0.9970	1.0264	1.0326	--	--	--	--	--	--	gram
Probe, Nozzle, hose weight	--	--	--	0.0022	0.0045	--	--	--	--	gram
Impinger and Rinse Volume	--	--	--	--	--	2775	2960	1750	2575	mL

ANALYST S. Guinnane
REVIEWER Greg Nicoll

Form EED-057 4/80

4.2 TRACE ELEMENT ANALYSIS RESULTS

COMMERCIAL TESTING & ENGINEERING CO.

Reply to
Instrument Analysis Division
490 Orchard Street
Golden, CO 80401

Phone: 303-278-9521

September 30, 1983

Mr. Christopher Mann
Acurex Corporation
P.O. Box 7555
Mountian View, CA 94039

RE: IAD #97-M661-116-14
Acurex Project 7601
Subcontract SW59159A
Release No. 9

Analytical Report

Fourteen samples were received for analysis on September 13, 1983. These samples were assigned our IAD identification #97-M661-116-14.

Trace element determinations using Spark Source Mass Spectrometry per EPA level 1 protocol will be reported in separate reports upon completion of analysis.

Arsenic and Antimony were determined on three of the samples using hydride generation atomic absorption spectrophotometry. Mercury was determined on all fourteen samples using flameless cold vapor atomic absorption spectrophotometry.

The results of these determinations are presented in Table No. I and No. II and are reported in parts per million (ppm) by weight on an "as received" basis.

Table No. I
(ppm by Weight)

Sample ID	Arsenic (As)	Antimony (Sb)
819381 HR Imp 2 & 3, Inlet	≤0.04	≤0.04
819382 HR Imp 2 & 3, Outlet	≤0.04	≤0.04
810380 HR Imp 2 & 3, Blank	≤0.04	≤0.04

Table No. II
(ppm by Weight)

Sample ID	Mercury (Hg)
819366 HR Filter, Inlet	0.125
819367 HR Filter, Outlet	0.140
819365 HR Filter, Blank	0.028
819369 HR XAD-2, Inlet	0.042
819370 HR XAD-2, Outlet	0.040
819368 HR XAD-2, Blank	0.024
819378 HR Imp 1, Inlet	≤0.0002
819379 HR Imp 1, Outlet	0.0003
819394 DE Imp 1	0.0004
819377 HR Imp 1 Blank	≤0.0002
819360 HR Lube Oil	0.062
819381 HR Imp 2 & 3, Inlet	0.0016
819382 HR Imp 2 & 3, Outlet	≤0.0002
819380 HR Imp 2 & 3, Blank	≤0.0002

If you have any questions concerning these results, please call.

Harold A. Connell
Harold A. Connell
Assistant Laboratory Manager

Robert L. Taylor
Robert L. Taylor, Ph.D., Mngr. 30 Sep 83.
Instrumental Analysis Division

Original Copy Watermarked
For Your Protection

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300

Reply to INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. Christopher Mann
Acurex Corporation
P.O. Box 7555
Mountain View, CA 94039

Date: October 24, 1983

AMENDED ANALYTICAL REPORT

Subcontract SW59159A
P. O. No.: Release 9

Analyst: J. Oldham

Sample No.: 819360
Lube Oil

IAD No.: 97-M661-116-14

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.2
Thorium		Gadolinium		Molybdenum	1	Titanium	≤0.2
Bismuth	0.2	Europium		Niobium		Scandium	≤0.1
Lead	2	Samarium		Zirconium	0.5	Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	20
Mercury	*0.062	Praseodymium		Strontium	10	Chlorine	10
Gold		Cerium		Rubidium		Sulfur	>560
Platinum	**0.4	Lanthanum		Bromine		Phosphorus	620
Iridium		Barium	970	Selenium	2	Silicon	30
Osmium		Cesium		Arsenic		Aluminum	5
Rhenium		Iodine	0.2	Germanium		Magnesium	4
Tungsten		Tellurium		Gallium		Sodium	30
Tantalum		Antimony		Zinc	260	Fluorine	≈5
Hafnium		Tin		Copper	1	Oxygen	NR
Lutetium		Indium	STD	Nickel	2	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.2	Carbon	NR
Thulium		Silver		Iron	5	Boron	0.1
Erbium		Palladium		Manganese	1	Beryllium	
Holmium		Rhodium		Chromium	≤0.2	Lithium	0.3
Dysprosium						Hydrogen	NR

*Flameless Atomic Absorption
**Possible Contamination

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.1 ppm
MC — Major Component > 1000 ppm
INT — Interference

Approved: Charles R. Wilson

COMMERCIAL TESTING & ENGINEERING CO.

Reply to

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300
INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. Christopher Mann
Acurex Corporation
P.O. Box 7555
Mountain View, CA 94039

Date: Oct. 24, 1983

Subcontract #SW59159A
Release 9

Analyst: Jim Oldham

P. O. No.:

Sample No.: 819369
XAD-2 Inlet

IAD No.: 97-M661-116-14

AMENDED ANALYTICAL REPORT
SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS
CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.2
Thorium		Gadolinium		Molybdenum	2	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	
Lead	0.5	Samarium		Zirconium	0.4	Calcium	160
Thallium		Neodymium		Yttrium		Potassium	35
Mercury	*0.042	Praseodymium		Strontium	0.5	Chlorine	5
Gold		Cerium	2	Rubidium		Sulfur	20
→ Platinum	**4	Lanthanum	3	Bromine	0.5	Phosphorus	5
Iridium		Barium	5	Selenium		Silicon	20
Osmium		Cesium	≤0.1	Arsenic	<0.1	Aluminum	5
Rhenium		Iodine	0.5	Germanium		Magnesium	5
Tungsten		Tellurium		Gallium	0.4	Sodium	15
Tantalum		Antimony		Zinc	1	Fluorine	≈5
Hafnium		Tin		Copper	4	Oxygen	NR
Lutetium		Indium	STD	Nickel	2	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	3	Carbon	NR
Thulium		Silver		Iron	10	Boron	<0.1
Erbium		Palladium		Manganese	0.2	Beryllium	
Holmium		Rhodium		Chromium	2	Lithium	0.2
Dysprosium						Hydrogen	NR

*Flameless Atomic Absorption
**Probable Contamination

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.1 ppm
MC — Major Component >1000 ppm
INT — Interference

Approved: Charles R. Wilson

COMMERCIAL TESTING & ENGINEERING CO.

Reply to
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300
INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. Christopher Mann
Acurex Corporation
P.O. Box 7555
Mountain View, CA 94039

Date: October 24, 1983

P. O. No.: Subcontract SW59159A
Release 9

AMENDED ANALYTICAL REPORT

Analyst: J. Oldham

Sample No.: 819370
XAD-2 Outlet

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS
CONCENTRATION IN PPM WEIGHT

IAD No.: 97-M661-116-14

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.5
Thorium		Gadolinium		Molybdenum	1	Titanium	2
Bismuth		Europium		Niobium		Scandium	
Lead	1	Samarium		Zirconium	1	Calcium	80
Thallium		Neodymium		Yttrium		Potassium	15
Mercury	*0.040	Praseodymium		Strontium	0.5	Chlorine	5
Gold		Cerium	0.5	Rubidium		Sulfur	10
XX Platinum	**0.5	Lanthanum	0.4	Bromine	0.5	Phosphorus	10
Iridium		Barium	4	Selenium	0.5	Silicon	280
Osmium		Cesium	≤0.1	Arsenic	<0.1	Aluminum	5
Rhenium		Iodine	0.5	Germanium		Magnesium	15
Tungsten		Tellurium		Gallium	0.1	Sodium	15
Tantalum		Antimony		Zinc	4	Fluorine	***≅20
Hafnium		Tin		Copper	10	Oxygen	NR
Lutetium		Indium	STD	Nickel	MC	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	1	Carbon	NR
Thulium		Silver		Iron	85	Boron	<0.1
Erbium		Palladium		Manganese	5	Beryllium	
Holmium		Rhodium		Chromium	160	Lithium	0.2
Dysprosium						Hydrogen	NR

*Flameless Atomic Absorption
**Probable Contamination
***Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.1 ppm
MC — Major Component > 1000 ppm
INT — Interference

Approved: Charles R. Wilson

L. Waterland 2-2260

67

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300
Reply to
INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. Christopher Mann
Acurex Corporation
P.O. Box 7555
Mountain View, CA

Date: Oct. 24, 1983

Subcontract SW59159A
P. O. No.: Release 9

Analyst: Jim Oldham

Sample No.: 819368
XAD-2 Blank

IAD No.: 97-M661-116-14

AMENDED ANALYTICAL REPORT
SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS
CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.3
Thorium		Gadolinium		Molybdenum	0.5	Titanium	5
Bismuth		Europium		Niobium		Scandium	
Lead	1	Samarium		Zirconium	0.4	Calcium	80
Thallium		Neodymium		Yttrium		Potassium	4
Mercury	*0.024	Praseodymium		Strontium	0.4	Chlorine	10
Gold		Cerium	0.4	Rubidium		Sulfur	10
? → Platinum	**4	Lanthanum	0.5	Bromine	1	Phosphorus	5
Iridium		Barium	5	Selenium	≤0.2	Silicon	10
Osmium		Cesium	≤0.1	Arsenic	<0.1	Aluminum	5
Rhenium		Iodine	0.5	Germanium		Magnesium	5
Tungsten		Tellurium		Gallium	0.3	Sodium	5
Tantalum		Antimony		Zinc	1	Fluorine	≈5
Hafnium		Tin		Copper	2	Oxygen	NR
Lutetium		Indium	STD	Nickel	5	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.1	Carbon	NR
Thulium		Silver		Iron	10	Boron	<0.1
Erbium		Palladium		Manganese	0.2	Beryllium	
Holmium		Rhodium		Chromium	3	Lithium	0.1
Dysprosium						Hydrogen	NR

* Flameless Atomic Absorption
** Probable Contamination

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.1 ppm
MC — Major Component >1000 ppm
INT — Interference

4-12

Approved: Charles R. Wilson

COMMERCIAL TESTING & ENGINEERING CO.

Reply to
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300
INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. Christopher Mann
Acurex Corporation
555 Clyde Avenue
P.O. Box 7555
Mountain View, CA 94039

Date: October 18, 1983

Analyst: J. Oldham

P. O. No.: Subcontract SW59159A Project #7601

Sample No.: 819366
HR Filter, Inlet

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

IAD No.: 97-M661-116-14

CONCENTRATION IN PPM WEIGHT of filter

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.3	Terbium		Ruthenium	≤0.01	Vanadium	3
Thorium	0.4	Gadolinium		Molybdenum	21	Titanium	>100
Bismuth	0.07	Europium		Niobium	1	Scandium	0.2
Lead	4	Samarium		Zirconium	6	Calcium	>100
Thallium		Neodymium	0.1	Yttrium	0.3	Potassium	>100
Mercury	*0.125	Praseodymium	0.2	Strontium	59	Chlorine	>100
Gold	INT	Cerium	1	Rubidium	0.08	Sulfur	>57
Platinum		Lanthanum	1	Bromine	2	Phosphorus	>100
Iridium		Barium	>100	Selenium	0.9	Silicon	>100
Osmium		Cesium	0.01	Arsenic	5	Aluminum	>9
Rhenium		Iodine	0.4	Germanium	0.05	Magnesium	>100
Tungsten	9	Tellurium	0.03	Gallium	1	Sodium	>23
Tantalum		Antimony	0.2	Zinc	>100	Fluorine	>100
Hafnium	0.2	Tin	0.4	Copper	6	Oxygen	NR
Lutetium		Indium	STD	Nickel	21	Nitrogen	NR
Ytterbium		Cadmium	0.07	Cobalt	>100	Carbon	NR
Thulium		Silver	4	Iron	>100	Boron	>100
Erbium		Palladium	0.07	Manganese	3	Beryllium	<0.01
Holmium		Rhodium	**0.8	Chromium	>100	Lithium	0.3
Dysprosium						Hydrogen	NR

*Flameless Atomic Absorption
**Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.01 μg/g of filter
MC — Major Component > 100 μg/g of filter
INT — Interference

Approved: Charles R. Wilson

4-13

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300
Reply to INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. Christopher Mann
Acurex Corporation
555 Clyde Avenue
P.O. Box 7555
Mountain View, CA 94039

Date: October 18, 1983

Analyst: J. Oldham

P. O. No.: Subcontract SW59159A Project #7601

Sample No.: 819367
HR Filter, Outlet

IAD No.: 97-M661-116-14

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS
CONCENTRATION IN PPM WEIGHT of filter

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.2	Terbium		Ruthenium	≤0.03	Vanadium	4
Thorium	0.6	Gadolinium		Molybdenum	7	Titanium	>100
Bismuth	0.3	Europium		Niobium	1	Scandium	0.8
Lead	11	Samarium	≤0.07	Zirconium	9	Calcium	>100
Thallium		Neodymium	0.4	Yttrium	0.4	Potassium	>100
Mercury	*0.140	Praseodymium	0.2	Strontium	53	Chlorine	>100
Gold	INT	Cerium	2	Rubidium	0.1	Sulfur	>82
Platinum		Lanthanum	1	Bromine	5	Phosphorus	>100
Iridium		Barium	>100	Selenium	1	Silicon	>100
Osmium		Cesium	<0.01	Arsenic	18	Aluminum	>13
Rhenium		Iodine	2	Germanium	0.07	Magnesium	>100
Tungsten	7	Tellurium	0.02	Gallium	1	Sodium	>34
Tantalum	0.1	Antimony	0.4	Zinc	>100	Fluorine	>100
Hafnium	0.3	Tin	1	Copper	40	Oxygen	NR
Lutetium		Indium	STD	Nickel	24	Nitrogen	NR
Ytterbium		Cadmium	2	Cobalt	>100	Carbon	NR
Thulium		Silver	2	Iron	>100	Boron	>100
Erbium		Palladium	0.4	Manganese	7	Beryllium	<0.01
Holmium		Rhodium	0.3	Chromium	>100	Lithium	0.8
Dysprosium						Hydrogen	NR

*Flameless Atomic Absorption

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.01 μg/g of filter
MC — Major Component > 100 μg/g of filter
INT — Interference

Approved: Charles R. Wilson

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300
Reply to INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. Christopher Mann
Acurex Corporation
555 Clyde Avenue
P.O. Box 7555
Mountain View, CA 94039

Date: October 18,1983

Analyst: J. Oldham

P. O. No.: Subcontract SW59159A Project #7601

Sample No.: 819365
HR Filter Blank

IAD No.: 97-M661-116-14

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

CONCENTRATION IN PPM WEIGHT of filter

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.09	Terbium		Ruthenium		Vanadium	1
Thorium	0.1	Gadolinium		Molybdenum	0.3	Titanium	>100
Bismuth		Europium		Niobium	0.7	Scandium	0.3
Lead	0.2	Samarium	≤0.1	Zirconium	9	Calcium	>100
Thallium		Neodymium	≤0.07	Yttrium	0.2	Potassium	81
Mercury	*0.028	Praseodymium	0.2	Strontium	5	Chlorine	>100
Gold		Cerium	0.8	Rubidium	0.05	Sulfur	>82
Platinum		Lanthanum	0.6	Bromine	1	Phosphorus	23
Iridium		Barium	63	Selenium	0.3	Silicon	>100
Osmium		Cesium		Arsenic	0.7	Aluminum	>13
Rhenium		Iodine	0.3	Germanium	0.01	Magnesium	>100
Tungsten		Tellurium	0.02	Gallium	0.4	Sodium	>34
Tantalum		Antimony	≤0.03	Zinc	2	Fluorine	≈46
Hafnium		Tin	0.1	Copper	0.4	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium	≤0.04	Cobalt	0.1	Carbon	NR
Thulium		Silver	0.06	Iron	32	Boron	>100
Erbium		Palladium		Manganese	0.7	Beryllium	<0.01
Holmium		Rhodium		Chromium	2	Lithium	0.4
Dysprosium						Hydrogen	NR

*Flameless Atomic Absorption

STD — Internal Standard
NR — Not Reported
All elements not detected <0.01 µg/g of filter
MC — Major Component >100 µg/g of filter
INT — Interference

Approved: Charles R. Wilson

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300
Reply to INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. Christopher Mann
Acurex Corporation
555 Clyde Avenue
P.O. Box 7555
Mountain View, CA 94039

Date: October 18, 1983

Analyst: J. Oldham

P. O. No.: Subcontract SW59159A Project #7601

Sample No.: 813378
HR Imp 1, Inlet

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS
CONCENTRATION IN μg/mL

IAD No.: 97-M661-116-14

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	<0.001
Thorium		Gadolinium		Molybdenum	0.04	Titanium	0.07
Bismuth		Europium		Niobium	0.03	Scandium	
Lead	0.01	Samarium		Zirconium	0.004	Calcium	0.8
Thallium		Neodymium		Yttrium		Potassium	0.9
Mercury	*≤0.0002	Praseodymium		Strontium	0.003	Chlorine	0.03
Gold		Cerium	0.002	Rubidium		Sulfur	>4
Platinum		Lanthanum	0.006	Bromine	0.005	Phosphorus	0.1
Iridium		Barium	0.03	Selenium	0.05	Silicon	0.5
Osmium		Cesium		Arsenic	<0.001	Aluminum	0.07
Rhenium		Iodine	0.006	Germanium		Magnesium	0.2
Tungsten	1	Tellurium		Gallium	0.002	Sodium	>1
Tantalum		Antimony		Zinc	0.2	Fluorine	≅0.5
Hafnium		Tin	≤0.001	Copper	0.06	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.002	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	<0.001	Carbon	NR
Thulium		Silver	0.01	Iron	0.08	Boron	0.001
Erbium		Palladium		Manganese	0.01	Beryllium	
Holmium		Rhodium		Chromium	0.02	Lithium	0.004
Dysprosium						Hydrogen	NR

* Flameless Atomic Absorption

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.001 μg/ml
MC — Major Component >10 μg/ml
INT — Interference

Approved: Charles R. Wilson

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300
Reply to INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. Christopher Mann
Acurex Corporation
555 Clyde Avenue
P.O. Box 7555
Mountain View, CA 94039

Date: October 18, 1983

Analyst: J. Oldham

P. O. No.: Subcontract SW59159A Project #7601

Sample No.: 819379
HR Imp 1, Outlet

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS
CONCENTRATION IN μg/mL

IAD No.: 97-M661-116-14

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.004
Thorium		Gadolinium		Molybdenum	≤0.02	Titanium	0.4
Bismuth		Europium		Niobium	0.002	Scandium	0.01
Lead	0.02	Samarium		Zirconium	≤0.003	Calcium	2
Thallium		Neodymium		Yttrium	0.002	Potassium	6
Mercury	*0.0003	Praseodymium		Strontium	0.009	Chlorine	MC
Gold		Cerium		Rubidium	**0.03	Sulfur	MC
Platinum		Lanthanum	≤0.005	Bromine	0.04	Phosphorus	0.3
Iridium		Barium	0.09	Selenium	INT	Silicon	1
Osmium		Cesium		Arsenic	<0.001	Aluminum	0.2
Rhenium		Iodine		Germanium		Magnesium	2
Tungsten	0.01	Tellurium	0.003	Gallium	0.08	Sodium	>5
Tantalum	**0.2	Antimony	≤0.005	Zinc	**MC	Fluorine	≈3
Hafnium		Tin		Copper	MC	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.3	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.01	Carbon	NR
Thulium		Silver	MC	Iron	0.5	Boron	0.002
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	0.2	Lithium	0.007
Dysprosium						Hydrogen	NR

*Flameless Atomic Absorption
**Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected <0.002 μg/mL
MC — Major Component >10 μg/mL
INT — Interference

Approved: Charles R. Wilson

COMMERCIAL TESTING & ENGINEERING CO.

Reply to

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300
INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

To: Mr. Christopher Mann
Acurex Corporation
555 Clyde Avenue
P.O. Box 7555
Mountain View, CA 94039

Date: October 18, 1983

Analyst: J. Oldham

P. O. No.: Subcontract SW59159A Project #7601

Sample No.: 819377
HR Imp 1 Blank

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

IAD No.: 97-M661-116-14

CONCENTRATION IN µg/mL

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.008
Thorium		Gadolinium		Molybdenum	**0.2	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	≤0.005
Lead	0.02	Samarium		Zirconium	0.007	Calcium	1
Thallium		Neodymium		Yttrium		Potassium	0.7
Mercury	*≤0.0002	Praseodymium		Strontium	0.002	Chlorine	0.3
Gold		Cerium		Rubidium		Sulfur	MC <100
Platinum		Lanthanum		Bromine	0.02	Phosphorus	0.8
Iridium		Barium	0.05	Selenium	0.07	Silicon	**2
Osmium		Cesium		Arsenic	0.002	Aluminum	0.09
Rhenium		Iodine		Germanium		Magnesium	0.08
Tungsten	0.02	Tellurium		Gallium	0.004	Sodium	1
Tantalum		Antimony		Zinc	**0.1	Fluorine	≈2
Hafnium		Tin		Copper	**0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.007	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	≤0.003	Carbon	NR
Thulium		Silver		Iron	0.1	Boron	0.004
Erbium		Palladium		Manganese	0.003	Beryllium	
Holmium		Rhodium		Chromium	0.03	Lithium	0.002
Dysprosium						Hydrogen	NR

*Flameless Atomic Absorption
**Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.003 µg/mL
MC — Major Component > 10 µg/mL
INT — Interference

Approved: Charles R. Wilson

COMMERCIAL TESTING & ENGINEERING CO.

Reply to

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 AREA CODE 312 953-9300
INSTRUMENTAL ANALYSIS DIVISION, 490 ORCHARD STREET, GOLDEN, COLORADO 80401, PHONE: 303 278-9521

SINCE 1908

To: Mr. Christopher Mann
Acurex Corporation
555 Clyde Avenue
P.O. Box 7555
Mountain View, CA 94039

Date: October 18, 1983

Analyst: J. Oldham

P. O. No.: Subcontract SW59159A Project #7601

Sample No.: 819394
DE Imp 1

SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS

IAD No.: 97-M661-116-14

Blind Duplicate of Imp 1 Outlet

CONCENTRATION IN μg/mL

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.005
Thorium		Gadolinium		Molybdenum	0.1	Titanium	0.2
Bismuth		Europium		Niobium	0.007	Scandium	≤0.002
Lead	0.02	Samarium		Zirconium	0.009	Calcium	2
Thallium		Neodymium		Yttrium	0.001	Potassium	0.8
Mercury	*0.0004	Praseodymium		Strontium	0.05	Chlorine	MC
Gold		Cerium		Rubidium	0.001	Sulfur	>8
Platinum		Lanthanum	≤0.006	Bromine	0.05	Phosphorus	0.2
Iridium		Barium	0.06	Selenium	INT	Silicon	2
Osmium		Cesium	**0.04	Arsenic	0.001	Aluminum	0.07
Rhenium		Iodine		Germanium		Magnesium	0.1
Tungsten	≤0.007	Tellurium		Gallium	0.03	Sodium	>3
Tantalum	≤0.005	Antimony		Zinc	4	Fluorine	**MC
Hafnium		Tin		Copper	MC	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.2	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.01	Carbon	NR
Thulium		Silver	MC	Iron	0.3	Boron	0.001
Erbium		Palladium		Manganese	0.07	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.07	Lithium	0.002
Dysprosium						Hydrogen	NR

*Flameless Atomic Absorption
**Heterogeneous

STD — Internal Standard
NR — Not Reported
All elements not detected < 0.001 μg/mL
MC — Major Component > 10 μg/mL
INT — Interference

Approved: Charles R. Wilson

COMMERCIAL TESTING & ENGINEERING CO.

SINCE 1908

Reply to
Instrumental Analysis Division
490 Orchard Street
Golden, CO 80401

Phone: 303-278-9521

December 19, 1983

Mr. Christopher Mann
Acurex Corporation
555 Clyde Avenue
Mountain View, CA 94039

Re: IAD #97-N137-116-09
Subcontract #SW59159A
Release #10

Analytical Report

Nine samples, previously analyzed for trace elements by spark source mass spectrometry under our IAD identification #97-M661-116-14, were logged under our IAD identification #97-N137-116-09 on November 18, 1983.

Samples #1, 2, and 3 were prepared in accordance with the procedure of ASTM, Part 05.05, Method D3683. Aluminum, barium, calcium, cobalt, chromium, iron, potassium, magnesium, sodium, silicon, titanium, and zinc were determined using flame atomic absorption spectrophotometry. Phosphorus was determined colorimetrically and sulfur was determined turbidimetrically. Boron, chlorine, and fluorine were not determined due to lack of enough sample for analysis. The results of these determinations are presented in Table No. I and are reported in total micrograms on the filter on an "as received" basis.

Appropriate dilutions, using deionized water, were made on samples #5, 6, 7, and 8. Chlorine and fluorine were determined using specific ion electrode methodology. Silver and sodium were determined using flame atomic absorption spectrophotometry. Sulfur was determined turbidimetrically. Selenium was determined using hydride generation atomic absorption spectrophotometry. The results of these determinations are presented in Table No. II and are reported in milligrams per litre (mg/L) on an "as received" basis.

Sample #4 was prepared in accordance with the procedure of the EPA SASS Train Level I Protocol. Nickel was determined using flame atomic absorption spectrophotometry. The result of this determination is presented in Table No. III and is reported in micrograms per gram (μg/g) on an "as received" basis.

4-20

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, IL 60148 AREA CODE 312 953-9300

BALTIMORE, MD • BILLINGS, MT • BIRMINGHAM, AL • BYESVILLE, OH • CHARLESTON, WV • CLARKSBURG, WV • CLEVELAND, OH • CONNEAUT, OH
DENVER, CO • GOLDEN, CO • HELPER, UT • HENDERSON, KY • HOUSTON, TX • JASPER, AL • MIDDLESBORO, KY • MOBILE, AL • NEW BETHLEHEM, PA
NEW ORLEANS, LA • NORFOLK, VA • PALISADE, CO • PIKEVILLE, KY • SALINA, UT • SO. HOLLAND, IL • TOLEDO, OH • NO. VANCOUVER, B.C. CAN.

A representative portion of sample #9 was diluted with MIBK. Calcium was then determined using flame atomic absorption spectrophotometry versus organometallic standards. Sulfur was determined using X-ray fluorescence spectrometry. The results of these determinations are also presented in Table No. III and are reported in micrograms per gram (μg/g) on an "as received" basis.

Table No. I
(Total micrograms on Filter)

ppm

Parameter	#1-819366 HR Filter, Inlet	#2-819367 HR Filter, Outlet	#3-819365 HR Filter, Blank
Aluminum (Al)	24058 830	[illegible] 440	$\leq$ 400
Barium (Ba)	1,400	1,700	---
Calcium (Ca)	2,800	2,200	$\leq$1,000
Cobalt (Co)	22	30	---
Chromium (Cr)	20	33	---
Iron (Fe)	1,100	260	---
Potassium (K)	12	10	---
Magnesium (Mg)	370	220	$\leq$ 100
Sodium (Na)	180	150	180
Phosphorus (P)	160	170	---
Sulfur (S)	620	720	$\leq$ 500
Silicon (Si)	4,300	2,300	$\leq$1,000
Titanium (Ti)	82	$\leq$60	$\leq$ 300
Zinc (Zn)	300	340	---

Table No. II
(mg/L - As Received)

ug/ml

Parameter	#5-819378 HR Imp 1, Inlet	#6-819379 HR Imp 1, Outlet	#7-819394 DE Imp 1	#8-819377 HR Imp 1, Blank
Silver (Ag)	---	1.75	2.12	---
Chlorine (Cl)	---	$\leq$ 3	$\leq$3	---
Fluorine (F)	---	4.18	4.44	---
Sodium (Na)	1,130	1,440	1,480	---
Sulfur (S)	1,800	9,000	4,800	$\leq$ 100
Selenium (Se)	---	$\leq$ 0.002	0.003	---

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Table No. III
(μg/g - As Received)

Parameter	#4-819370 HR XAD-2 Outlet	#9-819360 HR Lube Oil
Calcium (Ca)	---	334
Nickel (Ni)	140	---
Sulfur (S)	---	4,200

ppm

If you have any questions concerning these results, please call.

Harold A. Connell
Harold A. Connell
Assistant Lab Manager

Steven Poe - for
Robert L. Taylor, Ph.D., Mngr.
Instrumental Analysis Division

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4.3 TOTAL CHROMATOGRAPHABLE ORGANICS (TCO), GRAVIMETRIC ORGANICS (GRAV), INFRARED (IR) SPECTRA, AND GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS) OF TOTAL SAMPLE EXTRACTS

ACUREX Corporation

Energy & Environmental Division

November 14, 1983
Acurex ID#: 8306-050
Client PO#: 307736.62

Acurex/ES (CMEA)
M/S 2-2260

Attention: Larry Waterland

Sample: Honor Rancho Trains; Received 6/21/83

The above-referenced samples were analyzed by Level 1 protocol. The XAD and OMC extracts were combined per your instruction. Organic extracts were also analyzed for the semivolatile priority pollutants by gas chromatography/mass spectrometry employing a J&W SE-54 30 meter capillary column. The column was held at 30°C for 2 minutes, then ramped at 10°C per minute to 270°C. In addition to the priority pollutants, other organics including benzo(c)phenanthrene, dibenzo(c,g)carbazole, 7,12-dimethylbenzo(a) anthracene, 3-methylcholanthrene, and perylene were sought employing the computerized library search and manual interpretation. The assignment and quantitation of these organics is tentative since analytical standards of these compounds were not available for analysis. Benzo(c)phenanthrene, dibenzo(c,g)carbazole, 7,12-dimethylbenzo(a)anthracene, 3-methylcholanthrene and perylene were not detected in any of the samples at levels above 400 µg/train.

Half of the XAD-2 resin extract for the Inlet test was taken to near dryness during extraction of the resin. This may result in a lower TCO value.

Submitted by: Greg Nicoll 12/9/83
Greg Nicoll
Operations Manager

Viorica Lopez-Avila
Viorica Lopez-Avila, Ph.D.
Technical Director

GN/VLA/ats

Enclosures

ACUREX Corporation
ANALYSIS LABORATORIES

DATA REPORTING FORM

CUSTOMER CMEA
DATE November 14, 1983
CUSTOMER CONTRACT NO. 307736.52
ACUREX CONTRACT NO. 8306-050
RESULTS REPORT TO L. Waterland
TELEPHONE
ADDRESS
Honor Rancho

SAMPLE ID (CUSTOMER)	--	368	369	370	370					
SAMPLE ID (LAB)	Shake-out Blank	XAD Blank	XAD In$^+$	XAD Out$^+$	XAD out^{a+}					
PARAMETER										UNITS
GRAV	<2	<2	203	7	--					mg/train
TCO	<0.2	<0.2	270; 170^a	49	--					mg/train
Fluoranthene	<10	<10	15	<10	<10					ug/train
Pyrene	<10	<10	60	<10	<10					
Butyl benqyl phthalate	<10	<10	19	<10	<10					
Benz(a)anthracene	<10	<10	140	<10	<10					
Chrysente	<10	<10	53	<10	<10					
Benzofluoranthenes	<10	<10	52	<10	<10					
Phenol	<10	<10	<10	42	55					
Naphthalene	<10	<10	<10	710	800					
Acenaphthylene	<10	<10	1700	31	32					
Phenanthrene	<10	<10	1100	31	41					
Bis(2-ethylhexyl)-phthalate	<10	<10	1500	26^b	35^b					↓

$^+$ Plus OMC
a - Duplicate injection
b - Level normally found in laboratory blanks

ANALYST S. Kraska, S. Guinnane, C. Beeman
REVIEWER Greg [illegible]

Form EED-057 4/80

ACUREX Corporation
ANALYSIS LABORATORIES

DATA REPORTING FORM

CUSTOMER CMEA
DATE November 14, 1983
CUSTOMER CONTRACT NO. 307736.52
ACUREX CONTRACT NO. 8306-050
RESULTS REPORT TO L. Waterland
TELEPHONE
ADDRESS
Honor Rancho

SAMPLE ID (CUSTOMER)	--	368	369	370	370					
SAMPLE ID (LAB)	Shake-out Blank	XAD Blank	XAD In^{+}	XAD Out^{+}	XAD Out^{a+}					
PARAMETER										UNITS
Bis(2-chloroethyl)-ether	<10	<10	57	<10	<10					µg/train
Acenaphthene	<10	<10	450	<10	<10					↓
Fluorene	<10	<10	490	<10	<10					↓

$^{+}$ Plus OMC

a - Duplicate Injection

Form EED-057 4/80

ANALYST S. Kraska

REVIEWER Greg Nicoll

IR REPORT

SAMPLE: XAD Inlet 819369

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3571-2941	m	OH	Broad
2907	S	CH Alkane	
1673	S	C = o	
1538	m	Unassigned	
1439	m	CH_2 Methylene	
1266	m	C-O Stretch	
		Aliphatic hydrocarbon	
		Acid (-COOH)	

IR REPORT

SAMPLE: XAD Outlet 819370

Wave Number (cm^{-1})	Intensity	Assignment	Comments
		No detectable peaks	

IR REPORT

SAMPLE: XAD Blank 819368

Wave Number (cm^{-1})	Intensity	Assignment Comments
		No detectable peaks

IR REPORT

SAMPLE: Shake out blank

Wave Number (cm^{-1})	Intensity	Assignment	Comments
		No detectable peaks	

4.4 LIQUID CHROMATOGRAPHY (LC) SEPARATION OF THE INLET XAD-2 EXTRACT, WITH TCO, GRAV, AND IR ANALYSES OF LC FRACTIONS

ACUREX Corporation

Energy & Environmental Division

Acurex/ES (CMEA)
MS 2-2260

March 13, 1984
Acurex ID#: 8401-029
Client PO#: 307736.62

Attention: Larry Waterland

Sample: Honor Rancho Inlet XAD, Rock of Ages XADs;
Received 1/20/84

The above samples were subjected to liquid chromatography followed by TCO, gravimetric measurement, and infrared spectrophotometry according to Level 1 protocol.

Results are enclosed.

Prepared by: John S. Labash
John S. Labash
Chemist

Approved by: Greg Nicoll
Greg Nicoll
Manager, Inorganic Chemistry

JSL/GN/ats

SAMPLE: 819369 Honor Rancho XAD-2 Inlet

	TCO mg	GRAV mg	TCO + GRAV Total mg	Concentration mg/dscm
Total Sample[1]	220	203	420	
Taken for LC[2]	48	45	93	
Recovered[3]	3.7	37.6	41	

Fraction	TCO in mg				GRAV in mg				TCO + GRAV Total mg	Concentration mg/dscm
	Found in Fraction	Blank	Corrected	Total[4]	Found in Fraction	Blank	Corrected	Total[4]		
1	<0.2	<0.2	<0.2	<0.9	6.0	<0.5	6.0	27	27	
2	0.2	<0.1	0.2	0.9	0.8	<0.4	0.8	3.6	4.5	
3	3.0*	<0.1	3.0	14	7.4	<0.4	7.4	34	48	
4	0.7	0.2	0.5	2	5.6	<0.4	5.6	25	27	
5	<0.1	<0.1	<0.1	<0.5	3.2	<0.4	3.2	15	15	
6	<0.1	<0.1	<0.1	<0.5	11.6	<0.4	11.6	53	53	
7	<0.1	<0.1	<0.1	<0.5	3.6	0.6	3.0	14	14	
Sum	3.9	<0.9	3.7	17	38.2	0.6	37.6	172	188	

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample

*Duplicate injection gave 2.8

IR REPORT

SAMPLE: 1-29-1 LCF 1

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2945	S	CH Alkane	Weak Spectrum

IR REPORT

SAMPLE: 1-29-1 LCF 2

Wave Number (cm^{-1})	Intensity	Assignment Comments
		No Peaks

IR REPORT

SAMPLE: 1-29-1 LCF 3

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2940	S	CH Alkane	Weak
1715	S	C=O *	Spectrum
		* Tentative assignment	

IR REPORT

SAMPLE: 1-29-1 LCF 4

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2930	M	CH Alkane	
1700	S	C=0 *	Broad
1555	M	Not assigned	
			Weak Spectrum
		* Tentative assignment	

IR REPORT

SAMPLE: 1-29-1 LCF 5

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2930	S	CH Alkane	
1555	S	Not Assigned	

IR REPORT

SAMPLE: 1-29-1 LCF 6

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3360	M	OH	Broad
3065	W	=C-H Alkene	
2935	S	CH Alkane	
1710	S	C=O Stretch	
1605	W	C=C Alkene	
1555	M	Unassigned	
1450	W	CH$_2$	
1380	W	CH$_3$	
1278	W	C-O	
740	W	=C-H Alkene	

IR REPORT

SAMPLE: 1-29-1 LCF 7

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3540	S	OH*	Broad Peak
2940	W	CH Alkane	
1710	W	C=O	
			* Tentative assignment

IR REPORT

SAMPLE: 1-29-BLK LCF-1

Wave Number (cm^{-1})	Intensity	Assignment	Comments
		No Peaks	

IR REPORT

SAMPLE: 1-29-BLK LCF 2

Wave Number (cm^{-1})	Intensity	Assignment Comments
		No Peaks

IR REPORT

SAMPLE: 1-29-BLK LCF 3

Wave Number (cm^{-1})	Intensity	Assignment	Comments
		No Peaks	

IR REPORT

SAMPLE: 1-29-BLK LCF 4

Wave Number (cm^{-1})	Intensity	Assignment	Comments
		No Peaks	

IR REPORT

SAMPLE: 1-29-BLK LCF 5

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2935	S	CH Alkane	
			Weak spectrum

IR REPORT

SAMPLE: 1-29-BLK LCF 6

Wave Number (cm^{-1})	Intensity	Assignment	Comments
		No Peaks	

IR REPORT

SAMPLE: 1-29-BLK LCF 7

Wave Number (cm^{-1})	Intensity	Assignment	Comments
		No Peaks	

4.5 BIOASSAY RESULTS

CYTOTOXIC EVALUATION OF FIVE RESIN EXTRACT AND SIX ASH SAMPLES IN THE EPA LEVEL 1 RODENT CELL (CHO) CLONAL TOXICITY ASSAY

FINAL REPORT

SUBMITTED TO:

ACUREX CORPORATION
485 CLYDE AVENUE
MOUNTAIN VIEW, CALIFORNIA 94042

SUBMITTED BY:

LITTON BIONETICS, INC.
5516 NICHOLSON LANE
KENSINGTON, MARYLAND 20895

LBI PROJECT NO. 20993-442

REPORT DATE: APRIL 1984

PREFACE

These assays conform to the standard EPA Level 1 procedure for the Chinese hamster ovary cell (CHO) clonal toxicity assay as described in "IERL-RTP Procedures Manual: Level 1 Environmental Assessment Biological Tests"[1]. The data were evaluated and formatted as recommended in "Level 1 Biological Testing Assessment and Data Formatting"[2].

The CHO clonal toxicity assay has been shown to be a sensitive method for detecting cytotoxic activity for a variety of chemicals representing various chemical classes [3]. This assay is one of several recommended by EPA to identify, categorize and rank the pollutant potential of influent and effluent streams from industrial and energy-producing processes. This assay has been well validated with a wide range of positive and negative control chemicals and complex environmental samples.

All procedures and documents pertaining to the receipt, storage, preparation, testing and evaluation of the test material shall conform to Litton Bionetics, Inc. standard operating procedures, the U.S. Food and Drug Administration's Good Laboratory Practices Regulations of 1979[4] and the proposed U.S. Environmental Protection Agency's Good Laboratory Practice Guidelines.[5,6] Deviations from standard procedure shall be fully documented and noted in the report.

All test and control results in this report are supported by fully documented raw data which are permanently maintained in the files of the Department of Molecular Toxicology or in the archives of Litton Bionetics, Inc., 5516 Nicholson Lane, Kensington, Maryland 20895. Copies of raw data will be supplied to the sponsor upon request.

RESULTS

A. Interpretation

The results of the Chinese hamster ovary (CHO) clonal toxicity assays are presented in Tables 2 and 3. The calculated relative survival values were obtained by comparing the average number of colonies per dish for each of the assayed concentrations to the appropriate control value. The relative survival values were then plotted as functions of the applied concentration of test material per ml of culture medium in Figures 2 and 3. Curves were fitted to the data points in order to determine the EC_{50} value for each sample. The EC_{50} determined for each sample was used to rank the toxicity of each sample according to EPA Level 1 evaluation criteria.

1. HR XAD-2 extract, inlet (819369)

The HR XAD-2 extract, inlet sample in dimethyl sulfoxide (DMSO) was found to be toxic to Chinese hamster ovary (CHO) cells following 24 hours exposure. As shown in Table 2 and Figure 2, the ability of Chinese hamster ovary (CHO) cells to survive a 24-hour exposure to the test material rapidly decreased with increasing concentrations of test material. The lowest concentration tested, 0.1 µl/ml, had nearly 100 percent survival relative to the vehicle control, but survival dropped to about 31 percent at 0.3 µl/ml and to 0 percent survival at 0.6 µl/ml and higher concentrations.

The concentration of test material required to reduce the colony forming ability of CHO cells to 50 percent of the vehicle control level (EC_{50}) was estimated to be 0.23 µl of test material per ml of culture medium. Since the test material was prepared as a solution of organic material in DMSO at a concentration of 50.0 µg organics per microliter, this EC_{50} value was equal to 11.5 µg organic material per ml. When evaluated using the EPA Level 1 evaluation criteria[1], this value placed the test material in the moderate toxicity range, but at a position essentially on the moderate/high boundary at 10 µl/ml. Because results could be expected to fall on either side of the boundary in subsequent trials due to normal assay variation, the more conservative evaluation of moderate/high (M/H) toxicity was applied.

2 HR XAD-2 extract, outlet (819370)

The HR XAD-2 extract, outlet sample, when tested as a solution of organic material in DMSO (4.0 mg organics per ml), caused a rapid reduction in the ability of CHO cells to survive a 24-hour exposure period at concentrations greater than 3.0 µl/ml. As shown in Table 3 and Figure 3, survival relative to the vehicle control was above 95 percent over the concentration range of 0.1 to 3.0 µl/ml. Cytotoxicity was evident at 6.0 µl/ml which gave 23.3 percent relative survival while 10.0 and 20.0 µl/ml were completely toxic.

The concentration of test material required to produce a 50 percent reduction in cell survival following 24 hours of exposure was estimated to be 4.6 µl of test material per ml of culture medium. This concentration was equivalent to 18.4 µg of organic material per ml of culture medium. The sample therefore was ranked as having moderate (M) toxicity based upon the EPA Level 1 evaluation criteria for the CHO cytotoxicity assay.[1]

TABLE 2
CLONAL CYTOTOXICITY ASSAY

SAMPLE IDENTITY: HR XAD-2 EXTRACT, INLET.
SAMPLE CODE 819369

DESCRIPTION OF SAMPLE: DARK AMBER LIQUID

LBI ASSAY NO. 7330

DATE RECEIVED: JANUARY 16, 1984

TEST DATE: FEBRUARY 9, 1984

VEHICLE: DIMETHYL SULFOXIDE (DMSO)

CELL TYPE: CHO-K1-BH4

CELLS SEEDED PER DISH: 200

EC50 VALUE: 11.5 UG/ML (0.23 UL/ML)

TOXICITY CLASSIFICATION: MODERATE/HIGH (M/H)

PH ALTERATIONS: NONE

COMMENTS ON TREATMENT: SAMPLE SOLVENT EXCHANGED INTO DMSO. ORGANIC CONCENTRATION WAS 50.0 MG PER ML. (100 MG ORGANICS IN 2.0 ML DMSO.) 24 HOUR EXPOSURE PERIOD.

SAMPLE	APPLIED CONCENTRATION UL/ML	COLONY COUNTS DISH #1	DISH #2	DISH #3	AVERAGE COUNT	RELATIVE SURVIVAL[a] (PERCENT)	CLONING EFFICIENCY (PERCENT)
NC	---	154	163	161	159.3	100.0	79.7
VC, 1%	10	148	165	175	162.7	100.0	81.4
VC, 2%	20	152	150	132	144.7	100.0	72.4
TEST	0.1	162	157	155	158.0	97.1	
TEST	0.3	45[b]	58[b]	48[b]	50.3	30.9	
TEST	0.6	0	0	0	0.0	0.0	
TEST	1.0	0	0	0	0.0	0.0	
TEST	3.0	0	0	0	0.0	0.0	
TEST	6.0	0	0	0	0.0	0.0	
TEST	10.0	0	0	0	0.0	0.0	
TEST	20.0	0	0	S	0.0	0.0	

NC = NEGATIVE CONTROL, F12 MEDIUM

VC = VEHICLE CONTROL, PERCENT GIVEN FOR DIMETHYL SULFOXIDE (DMSO)

S = PLATE NOT SET UP TO CONSERVE LIMITED SAMPLE

[a] RELATIVE TO 2% VC FOR 20 UL/ML TREATMENT AND TO 1% VC FOR OTHER TREATMENTS

[b] REDUCED COLONY SIZE

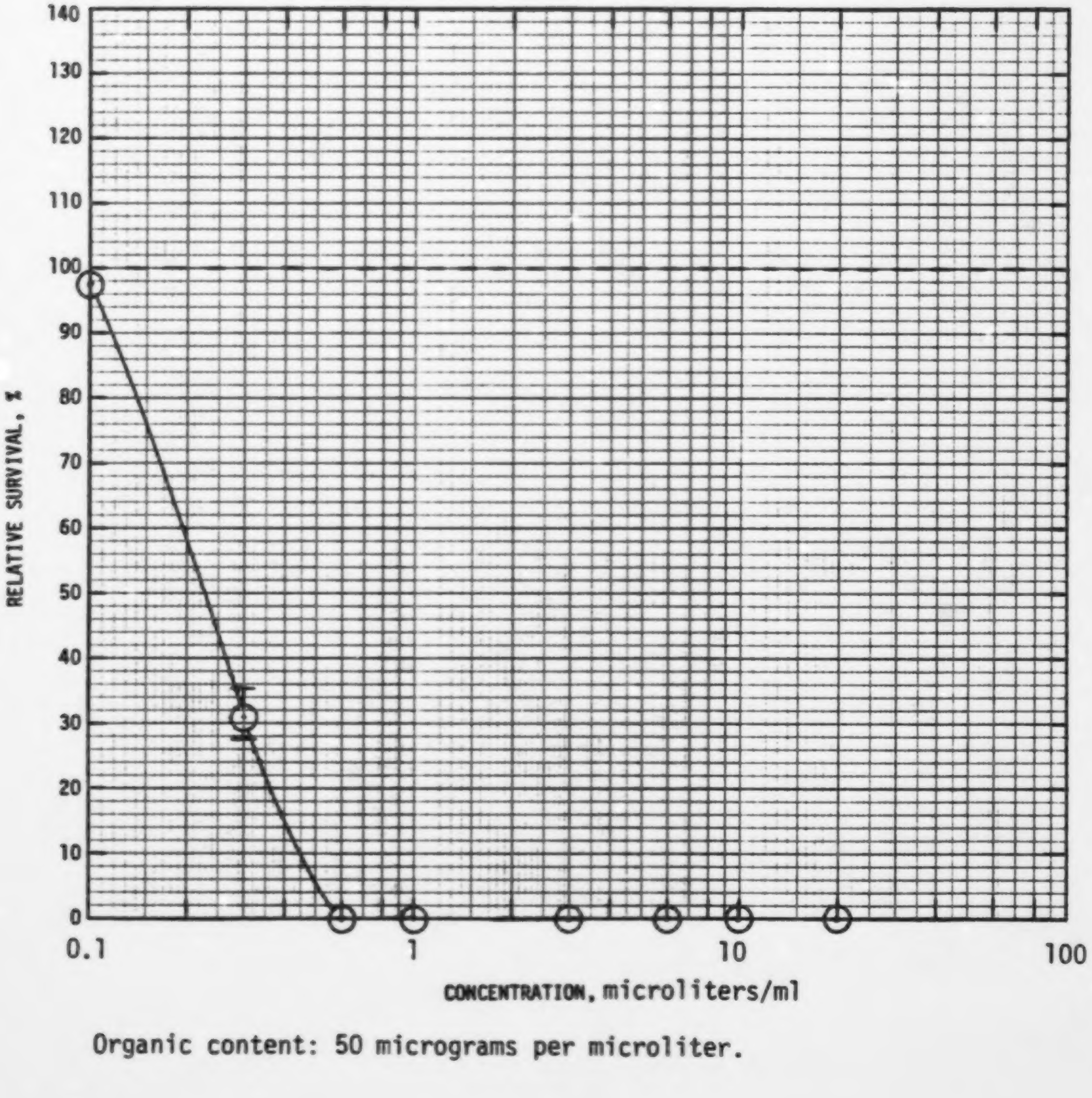
FIGURE 2

RODENT CELL (CHO) CLONAL TOXICITY ASSAY

EC_{50} DETERMINATION

HR XAD-2 EXTRACT, INLET

SAMPLE CODE 819369



Organic content: 50 micrograms per microliter.

TABLE 3
CLONAL CYTOTOXICITY ASSAY

SAMPLE IDENTITY: HR XAD-2 EXTRACT, OUTLET.
SAMPLE CODE 819370

DESCRIPTION OF SAMPLE: CLEAR, LIGHT YELLOW LIQUID

LBI ASSAY NO. 7331

DATE RECEIVED: JANUARY 23, 1984

TEST DATE: FEBRUARY 9, 1984

VEHICLE: DIMETHYL SULFOXIDE (DMSO)

CELL TYPE: CHO-K1-BH4

CELLS SEEDED PER DISH: 200

EC50 VALUE: 18.4 UG/ML (4.6 UL/ML)

TOXICITY CLASSIFICATION: MODERATE (M)

PH ALTERATIONS: NONE

COMMENTS ON TREATMENT: SAMPLE SOLVENT EXCHANGED INTO DMSO. ORGANIC CONCENTRATION WAS 4.0 MG PER ML. (8.0 MG ORGANICS IN 2.0 ML DMSO.) 24 HOUR EXPOSURE PERIOD.

SAMPLE	APPLIED CONCENTRATION UL/ML	COLONY COUNTS DISH #1	DISH #2	DISH #3	AVERAGE COUNT	RELATIVE SURVIVAL[a] (PERCENT)	CLONING EFFICIENCY (PERCENT)
NC	---	180	193	173	182.0	100.0	91.0
VC, 1%	10	161	152	176	163.0	100.0	81.5
VC, 2%	20	173	160	169	167.3	100.0	83.7
TEST	0.1	180	171	189	180.0	110.4	
TEST	0.3	166	161	147	158.0	96.9	
TEST	0.6	158	168	150	158.7	97.4	
TEST	1.0	155	174	161	163.3	100.2	
TEST	3.0	154[b]	164[b]	156[b]	158.0	96.9	
TEST	6.0	40[b]	31[b]	43[b]	38.0	23.3	
TEST	10.0	0	0	0	0.0	0.0	
TEST	20.0	0	0	S	0.0	0.0	

NC = NEGATIVE CONTROL, F12 MEDIUM

VC = VEHICLE CONTROL, PERCENT GIVEN FOR DIMETHYL SULFOXIDE (DMSO)

S = PLATE NOT SET UP TO CONSERVE LIMITED SAMPLE

[a] RELATIVE TO 2% VC FOR 20 UL/ML TREATMENT AND TO 1% VC FOR OTHER TREATMENTS

[b] REDUCED COLONY SIZE

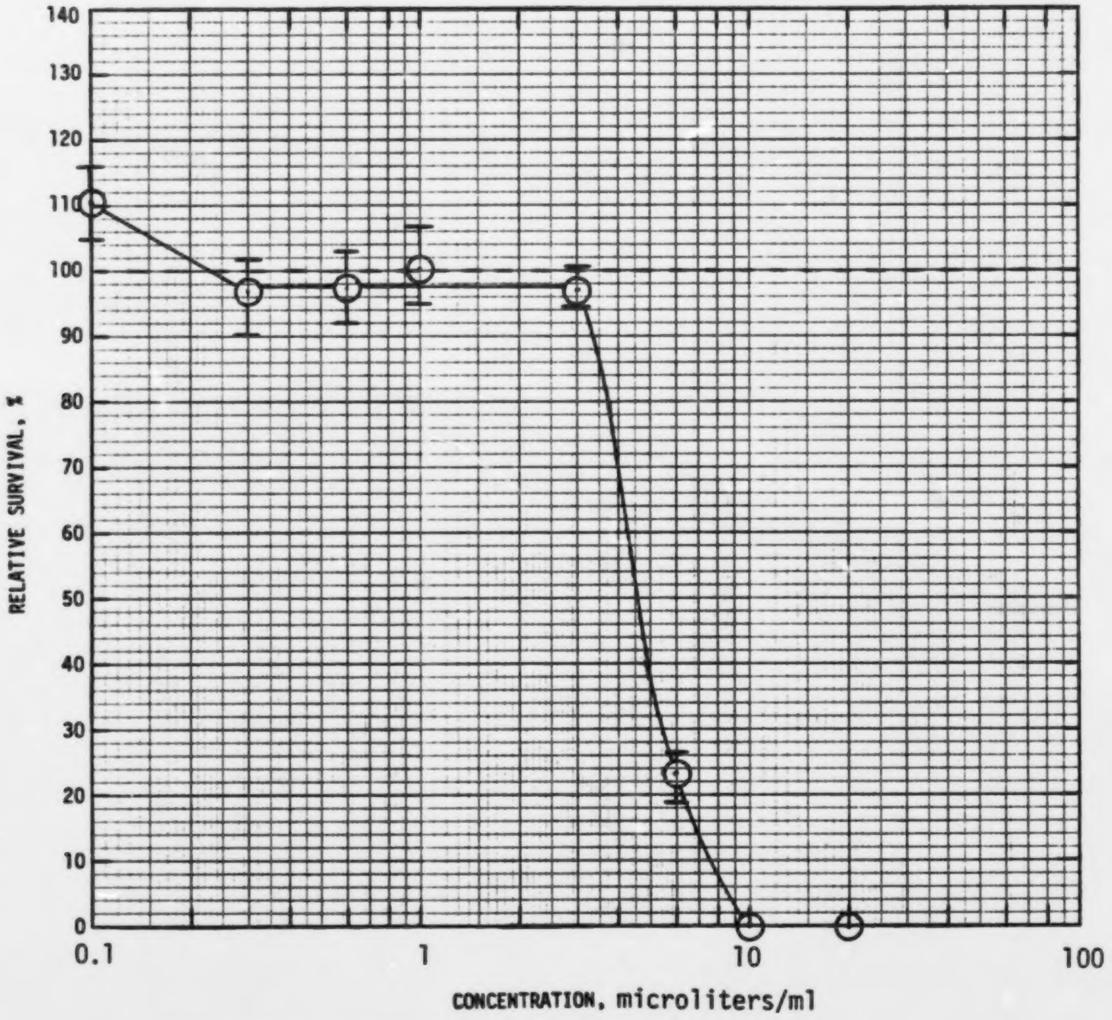
FIGURE 3

RODENT CELL (CHO) CLONAL TOXICITY ASSAY

EC_{50} DETERMINATION

HR XAD-2 EXTRACT, OUTLET

SAMPLE CODE 819370



Organic content: 4.0 micrograms per microliter.

VII. ASSAY ACCEPTANCE CRITERIA

An assay is considered acceptable for evaluation of the test results if the following criteria are met:

- The average cloning efficiency of the CHO-K1 cells in the negative controls is 70 percent or greater, but not exceeding 115 percent.
- The distribution of colonies in the treated cultures is generally uniform over the surface of the culture dish.
- The data points for each test concentration critical to the location of the EC_{50} are the averages of at least two treated cultures.
- A sufficient number of test concentrations are available to clearly locate the EC_{50} within a toxicity region as defined under Assay Evaluation Criteria.
- If the EC_{50} value is greater than 1000 µg/ml, 600 µliters of aqueous sample/ml, or 20 µliters of nonaqueous sample/ml, the plotted curve does not exceed 110 percent of the negative control.

VIII. ASSAY EVALUATION CRITERIA

The EC_{50} value represents the concentration of test material that reduces the colony-forming ability of CHO cells to 50 percent of the vehicle or negative control value. EC_{50} values are determined graphically by fitting a curve through relative survival data points plotted as a function of the logarithm of the applied concentration. Each data point normally represents the average of three culture dishes. In order to indicate the variability of the data, the high and low colony counts for each concentration are used to calculate relative survivals for those values. The range is shown by a bar at the high and low relative survival values above and below the position of the plotted average. If no bar is shown, the variability was within the size of the symbol. Statistical analysis is unnecessary in most cases for evaluation.

The toxicity of the test material is evaluated as high, moderate, low, or nondetectable according to the range of EC_{50} values defined in the following table:

TABLE 14. CHO ASSAY EVALUATION CRITERIA

Toxicity[a]	Solids (EC_{50} in µg/ml)	Aqueous Liquids (EC_{50} in µl/ml)	Nonaqueous Liquids[b] (EC_{50} in µl/ml)
High	<10	<6	<0.2
Moderate	10 to 100	6 to 60	0.2-2
Low	100 to 1000	60 to 600	2-20
Not Detectable	>1000	>600	>20

[a] Evaluation criteria formulated by Litton Bionetics, Inc. for IERL-RTP Procedures Manual: Level 1 Environmental Assessment Biological Tests[1].

[b] Criteria for nonaqueous liquids are tentative and under evaluation. If the organic or solids content is known, the sample is evaluated under the solids criteria.

Another evaluation scheme is proposed for extracts obtained from stack or exhaust gas streams such as those collected with SASS train collection systems. The proportion of the total gas volume corresponding to the volume of extract used in the bioassay is calculated and expressed as liters of gas per milliliter of culture medium (L/ml) or as dry standard cubic feet of gas per milliliter of culture medium (DSCF/ml). A criterion of 1000 L/ml is set as the limit for nondetectable toxicity. This gas volume corresponds to the average volume breathed by humans over a 2-hour period. The subsequent toxicity ranges are defined by 10-fold dilution steps to conform to standard procedure. The toxicity ranges are defined in the following table for liter and dry standard cubic feet units:

TABLE 15. CHO ASSAY EVALUATION CRITERIA
BASED UPON EQUIVALENT VOLUME OF EXHAUST GAS

Toxicity	EC_{50} In Liters/ml (L/ml)	EC_{50} In Dry Standard Cubic Feet/ml (DSCF/ml)
High	<10	<0.35
Moderate	10-100	0.35-3.5
Low	100-1000	3.5-35
Nondetectable	>1000	>35

REFERENCES

1. Brusick, D.J. and Young, R.R.: IERL-RTP Procedures Manual: Level 1 Environmental Assessment Biological Tests. EPA-600/8-81-024, NTIS PB 82-228966, Litton Bionetics, Inc., Kensington, MD, October 1981, 150 pp.

2. Brusick, D.J.: Level 1 Biological Testing Assessment and Data Formatting. EPA-600/7-80-079, NTIS PB 80-184914, Litton Bionetics, Inc., Kensington, MD, April 1980, 100 pp.

3. Brusick, D.J. and Young, R.R.: Level 1 Bioassay Sensitivity. EPA-600/7-81-135, NTIS PB 82-221201, Litton Bionetics, Inc., Kensington, MD, August 1981, 52 pp.

4. DHEW Food and Drug Administration "Nonclinical Laboratory Studies; Good Laboratory Practice Regulations" Federal Register, volume 43, No. 247, pp. 59986-60020, Part II, December 22, 1978.

5. Proposed Health Effects Test Standard for Toxic Substances Control Act Test Rules; Good Laboratory Practice Standards for Health Effects. Federal Register, Part II, volume 44, No. 91, May 1979 and Part IV, volume 44, No. 145, July, 1979.

6. Guidelines for Registering Pesticides in the United States: Proposed Good Laboratory Practice Guidelines for Toxicology Testing. Federal Register, volume 45, No. 77, April, 1980.

4.6 NATURAL GAS FUEL ANALYSIS

ACUREX Corporation

COMMUNICATION MEMO

☐ TELEPHONE ☐ CONFERENCE

DATE

TIME

SERIAL/FILE NO.

PAGE

PERSON CONTACTED Bud Cooper

TELEPHONE (213) 806-4350

COMPANY So. Calif. Gas Co.

PREPARED BY Mason

LOCATION LAX

☐ INFO ONLY ☐ ACTION REQUIRED

SUBJECT Honor Rancho Gas Analysis

RESPONSIBLE PERSON

NOTES AND DISCUSSION

Cooper has completed the gas analysis for the CMEA Honor Rancho test.

O_2	0.073 %
N_2	1.119
CO_2	0.890
CH_4	90.119
C_2H_6	6.294
C_3H_8	1.247
Iso-butane	0.094
n-butane	0.106
Iso-pentane	0.029
n-pentane	0.029
C_6 and Higher	0.003
	100.003 %

Bud would like to get a copy of test results when available

CC: Waterland, DaKos, Carlo, DeRosier

☐ CONTINUED ON BACK